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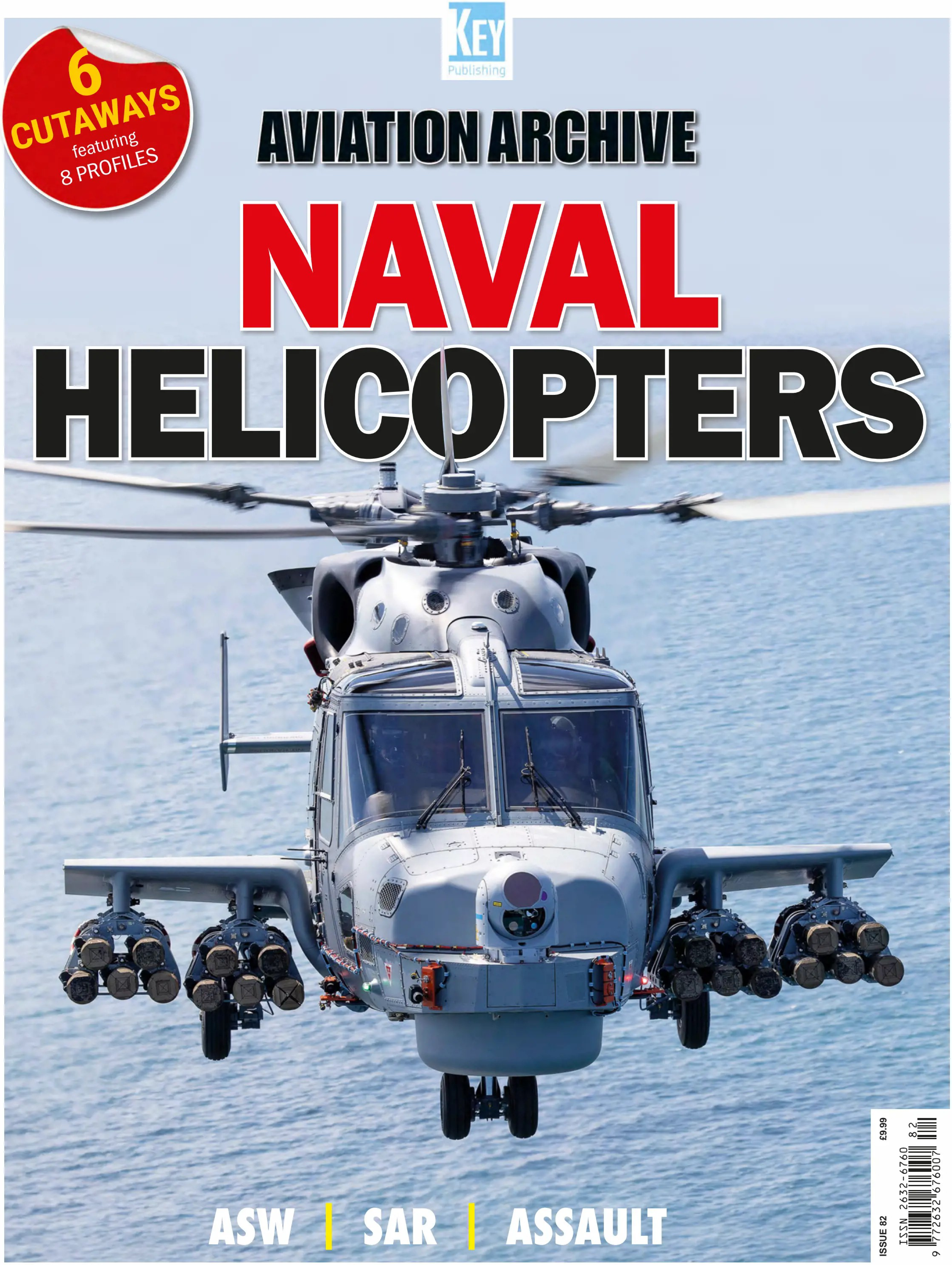

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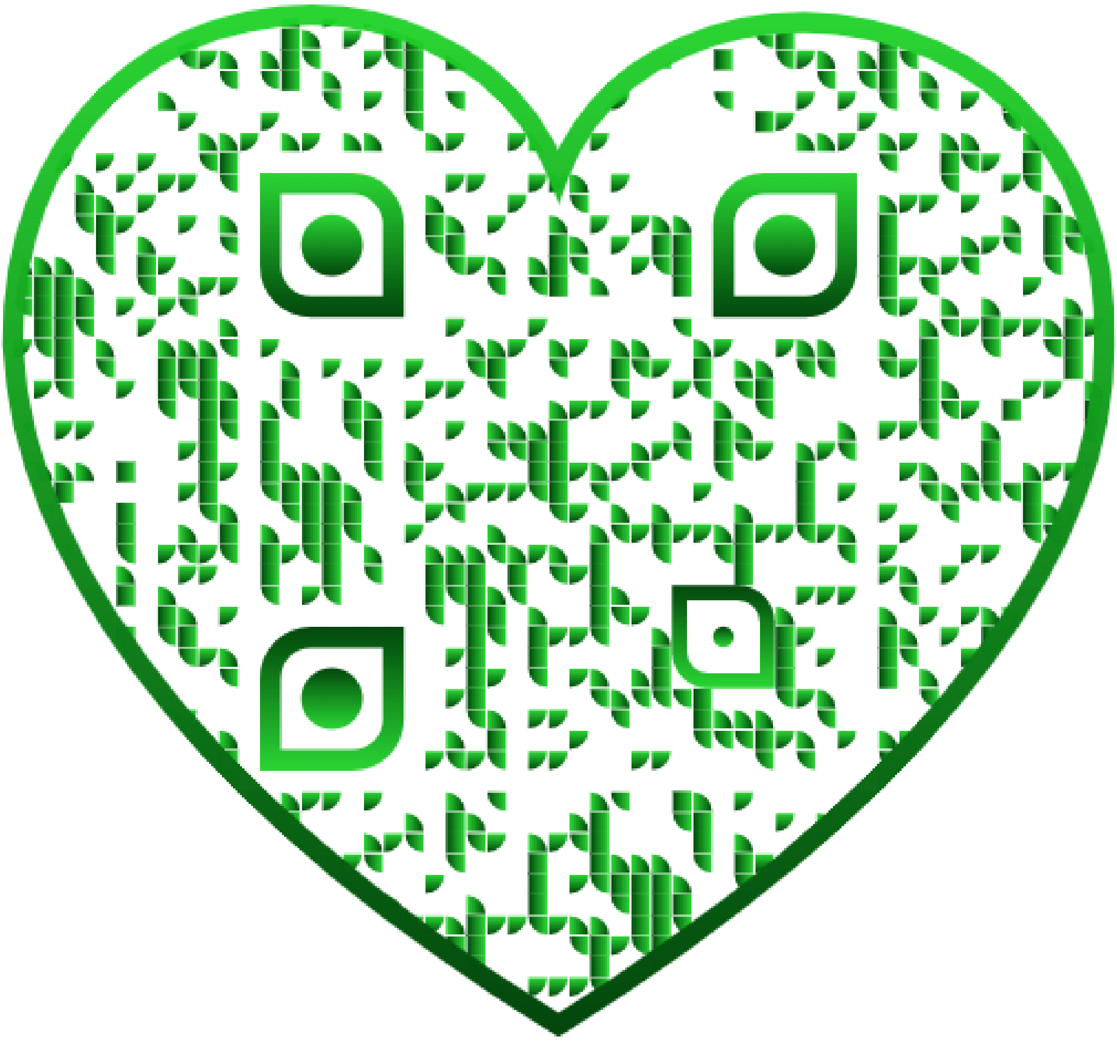

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A Royal Navy Merlin of No. 845 NAS in flight near the British Virgin Islands. *LPhot Joe Cater/Royal Navy Crown Copyright*

Cover Photo: A Leonardo Wildcat armed with Thales Martlet missiles. *rLeonardo*

Naval Helicopters

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A view from the cabin of a Lynx HMA.8 approaching Portland, Dorset on a July 2009 flight from Yeovilton. *Jim Winchester*

Welcome Aboard

With the advent of the practical helicopter in the 1930s it was recognised that they might be useful on ships, for such things as locating submarines, spotting the fall of gunfire, transporting the odd thing or person here and there and picking up men overboard. Since those days the number of possible roles has proliferated, as has the variety of rotorcraft taken to sea.

The great advantage of rotary-winged aircraft is that they need a small area for landing and take-off. It would be hard to find a production helicopter that has never operated from a ship's deck. Some, such as the Chinook, Apache and Puma/Super Puma do so regularly, despite normally lacking rotor or tail folding and thus the ability to be kept hangared aboard. They have been left ashore for this issue as my criteria is broadly that the helicopter has a maritime role and folds up for shipboard storage, although several early types didn't, nor a few more modern machines such as the AB.212.

I have been privileged to fly in examples of the Lynx (RN and Danish), Alouette III, AB.212, Sea King (Westland and Sikorsky), Merlin (RAF and Portuguese) and MV-22B Osprey and have landed on British, French, Danish, Spanish and American warships. I appreciate the skills needed to fly a helicopter for a pitching deck and salute those men and women for whom it is all in a day's work.

For this issue David Willis has written the entries for the Mi-14, Seahawk, Lynx, Westland Sea King and the Dhruv. The profile illustrations are by Rolando Ugolini and design is by Paul Sander. Uncredited images in this edition come from the Key Archive and others are only individually credited if sourced from elsewhere.

Jim Winchester

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Carrying ten Martlet light multirole missiles, a Wildcat HMA.2 flies by HMS Kent in the Philippine Sea during a 2021 deployment. New weapons allow small helicopters to have a considerable punch against smaller surface targets.

LPhot Dan Rosenbaum/Royal Navy Crown Copyright

Naval Helicopters

All at Sea

Helicopters brought new capabilities to the world's navies, performing a myriad of ship-based roles from transport to rescue to extending the reach of a warship's own weapons, both in attack and defence. Today they are being challenged or at least complemented by unmanned rotorcraft.

The history of shipboard rotorcraft goes back further than many would imagine, to the middle of World War Two when Germany carried out trials and then active use of several types for gunnery spotting and anti-submarine patrol. In Britain, Autogyros were tested aboard an aircraft carrier and a merchantman, before Sikorsky R-4s joined the escort of an Atlantic convoy. These early efforts showed that helicopters could operate from ships in the open ocean. With no sensors beyond binoculars and no weapons, their use against submarines was limited, but they could spot a periscope wake and even the presence of a helicopter could cause a submarine to dive.

Helicopter pioneer Igor Sikorsky saw the helicopter primarily as a rescue machine. He said "If a man is in need of rescue, an airplane can come in and throw flowers on him, and that's just about all. But a direct lift aircraft could come in and save his life." By May 1941, his VS-300 was demonstrating an endurance of greater than 90 minutes and the ability to operate from water using floats. Soon more sophisticated machines were adopted by the US Navy and Coast Guard. It was largely through the enthusiasm of one

Helicopters allowed troops to be lifted to inland objectives without costly beach assaults. Here Marines of 42 Commando wait to board a Wessex HAS.1 aboard HMS Bulwark somewhere west of Aden in March 1961.

ROYAL NAVY
XM842

USCG officer, Capt. Frank Erickson, that the helicopter was quickly adopted for maritime use, despite opposition from the Navy. Erickson proposed the convoy escort, pushed the use of dipping sonar for finding submarines and led the development of the helicopter for life-saving missions in peacetime. The Navy Helicopter School, operated by the Coast Guard, graduated 97 helicopter pilots by the time it closed in February 1945.

At first, what to call helicopters proved elusive. 'Whirly bird' was commonly used and 'chopper' caught on, but 'flutter buggy' and 'egg beater' also appeared in contemporary press accounts. Several new roles emerged during the Korean War: Ship-to-shore troop lift, medical evacuation (medevac) and combat search-and-rescue (CSAR). The US Marines in particular adopted helicopters for these missions, particularly troop lift, which would revolutionise their concept of operations.

Other nations adopted helicopters for the same role, which the UK called commando assault, conducting their first major such operation at Suez in 1956. From 1963 Indonesia sent raids into British Borneo under a policy of 'confrontation' with the UK. The response involved many helicopters from the RAF and RN, which were crucial in countering the insurgency. The Whirlwind and Wessex were heavily used as troop lifters and for supplying remote outposts.

The USMC pioneered combat medical evacuation (medevac) in Korea with such types as the Sikorsky HO5S, which loaded the casualty somewhat awkwardly through the front windscreen as seen in this April 1953 image of a VMO-6 aircraft. NARA

VANGUARD
544
NAVY
HM-14

The versatility of naval helicopters is shown by an MH-53E Sea Dragon assisting with relief efforts in the aftermath of Hurricane Maria in Puerto Rico in 2017. HM-14 'Vanguard' is normally assigned the airborne mine countermeasures mission. *Taylor King/USN*

At first they were controlled centrally, but later subordinated to brigade commanders, which allowed a much faster reaction to reports of enemy activity. The Commando helicopters became known as 'Junglies', a name which has stuck, even when they have operated in Norway or Afghanistan.

The limited carrying capacity of early ASW helicopters saw the search and attack roles split across two helicopters, with the 'hunter' operating sonar and the 'killer' prosecuting the attack. Flight endurance was low, especially when long periods of hovering were required, and engines and gearboxes suffered. More powerful engines that could run for longer at lower settings partially addressed this problem, but their increased noise and vibration overwhelmed the sonar operators. Not until turbine-powered helicopters arrived did helicopters become a truly useful ASW weapon. Adoption of kerosene-fuelled engines also allowed gasoline storage to be eliminated from many ships, improving safety and saving space.

Until the 1960s, many navies were still operating large numbers of 1940s-era frigates and destroyers, which usually had a gun turret in the most suitable location for a helicopter deck and hangar. Admirals were reluctant to sacrifice firepower, but a number of ships were converted with a small pad to operate the Q-50 DASH (Drone Anti-Submarine Helicopter). Somewhat ahead of its time, this unmanned rotorcraft was controlled from the ship and could carry various anti-sub weapons including torpedoes and the B57 nuclear depth bomb (NDB). This was fine as the Q-50 was considered expendable in wartime. Unfortunately, many expended themselves in peacetime, failing to recover to the launching ship, and rotary-winged drones would have to make way for the helicopter for the time being.

Nuclear weapons were not restricted to one-way drones. The USA, UK and USSR all fielded them on naval helicopters. The British WE.177 served with the Royal Navy from 1966-1992 and was based on the US W59 warhead with a series of yields ranging from 0.5 kilotons for use inshore or close to population centres up to 10kt for the open ocean. The principle was that one didn't have to be too accurate with an NDB as the water hammer effect of a nuclear detonation would destroy any submarine within a large radius. It would likely also destroy the delivery vehicle, so helicopter pilots tasked with this mission thought it would be just as one-way for them as for the DASH drone.

Helicopters solved a dilemma of underwater mine clearance whereby the lead ship in a flotilla of minesweepers would probably discover its first mine the hard way. By towing a sled ahead of the ships, mines could be brought to the surface where they could be destroyed by gunfire, either from the ships or the helicopter itself. The idea was first tested by the US Navy with the Bell HSL in 1957-59 and was perfected with the Sikorsky RH-3D and RH-53D. Today it is a somewhat neglected art in the west with only a few USN MH-53Es and Japanese MCH-101s allocated to the specific helicopter minesweeping mission.

Airborne Early Warning (AEW) is a role ideally suited to helicopters, but one that was neglected by some navies for many years. Royal Navy experience of air and missile attacks in the Falklands spurred the rapid introduction of the Sea King AEW.2, which entered service just after hostilities ended. In Russia, development of an AEW helicopter was slow until the Indian Navy injected funds into the Ka-31 project in the 1990s.

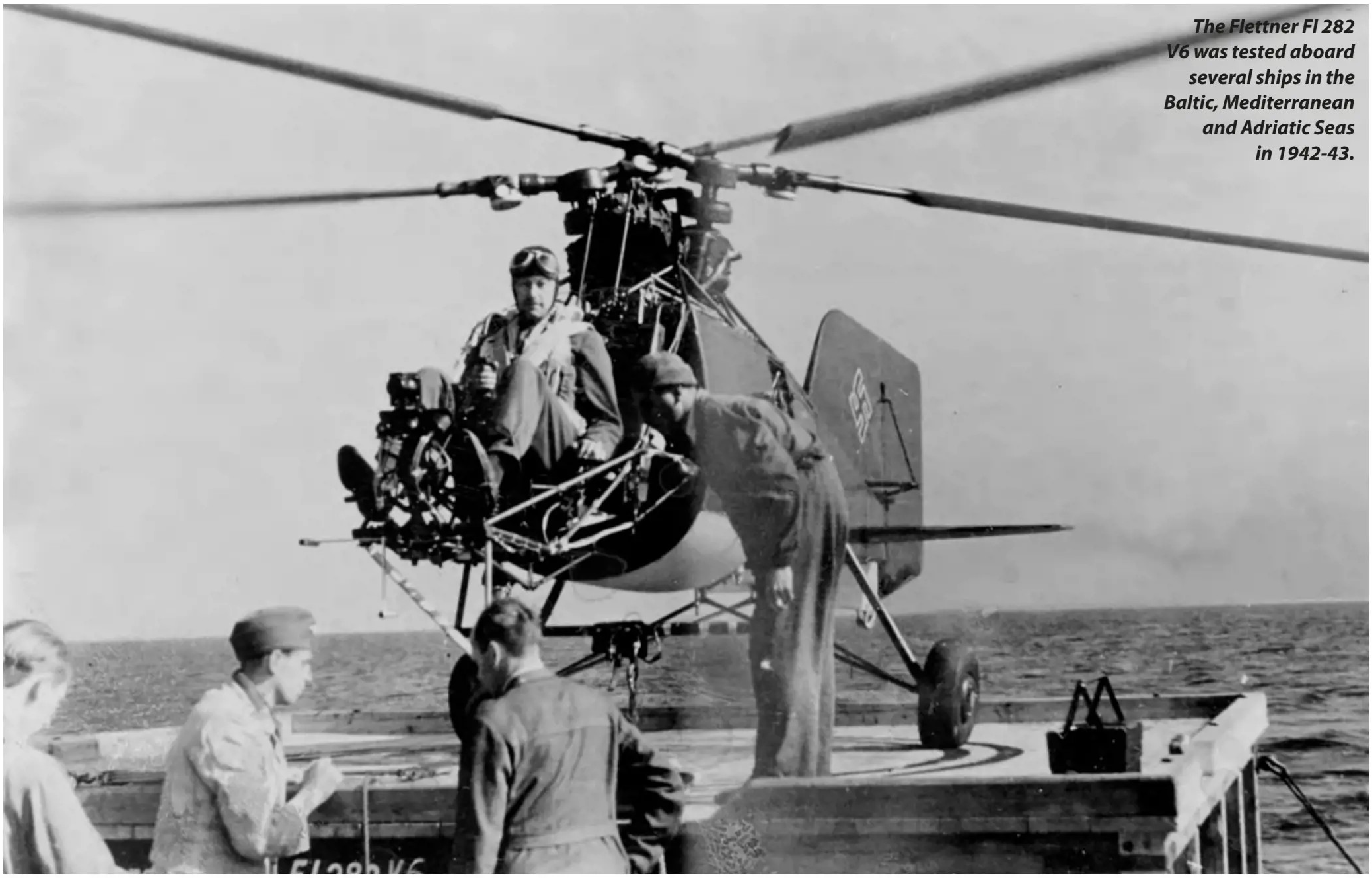
In the anti-surface warfare mission (ASuW), the development of guided missiles allowed the helicopter to extend the striking reach of a surface fleet's weapons. The Sea Skua was successfully employed against Iraqi vessels by Royal Navy Lynxes in the 1991 Gulf War. Some long-range missiles such as the MBDA MARTE-2 or Exocet can only be launched by the larger helicopters. Newer smaller weapons such Thales Martlet light multi-role missile can be carried in numbers by the Wildcat, enhancing fleet defence against fast attack craft and unmanned surface vessels (USVs), which have become an increasing threat.

The Kamov Ka-31 entered service in the 1990s in the Airborne Early Warning role with Russia and India. Here an Indian Navy example flies by with its radar stowed under the fuselage. *David Willis*

Despite all the effort put into ASW over the decades, there have been few engagements between helicopters and submarines. The Cuban Missile Crisis saw subs forced to the surface by helicopters and in 1982 the Argentine *Santa Fe* was disabled by missile, gun and depth charge attack at South Georgia by three types of RN helicopter, but in the Falklands War, the Royal Navy's rotorcraft mainly depth charged 'biologicals' (whales). This is not to dismiss the undoubted deterrent effect on the submarine captain of having armed sonar-pinging helicopters screening the area around any modern task group.

As with many other aspects of modern aviation, UASs or drones are playing an ever-increasing role. Rotory-winged unmanned aerial systems (RWUAS) like the Saab Skeldar, Schiebel Camcopter and Leonardo AWHero are cheaper to buy, more economical to run and stealthier than manned helicopters. They take up less space and are suitable for patrol vessels unable to take a helicopter. The current buzzword is Manned-unmanned teaming (MUM-T), where UAVs work with helicopters to expand the maritime picture available to a task group's commander. They are especially useful teaming with less-sophisticated support helicopters as they can augment their relatively limited sensors. A shipboard UAV still takes up valuable hangar space and the commander's choice may have to be between embarking a helicopter or a RWUAS. In some cases as smaller helicopter might be an advantage, as there may be room to have both. A drone can't carry people or significant cargo, or perform rescues or many of the myriad of other tasks assigned to helicopters since World War Two. The future probably lies with a mix of manned helicopters for the big jobs and drones for the more niche maritime tasks. ■

A Peregrine Rotary Wing UAV operated by 700X Naval Air Squadron tethered to the flight deck of HMS Lancaster during trials in the Gulf of Oman in August 2024. The Peregrine is based on the Austrian Schiebel S-100 Camcopter. *Lt Cdr Fraser Simon/Royal Navy Crown Copyright*



The Flettner Fl 282 V6 was tested aboard several ships in the Baltic, Mediterranean and Adriatic Seas in 1942-43.

German Pioneers

Small Sea Birds

Germany pioneered the use of military rotorcraft, and two types of these saw limited operational service from ships at sea during World War Two.

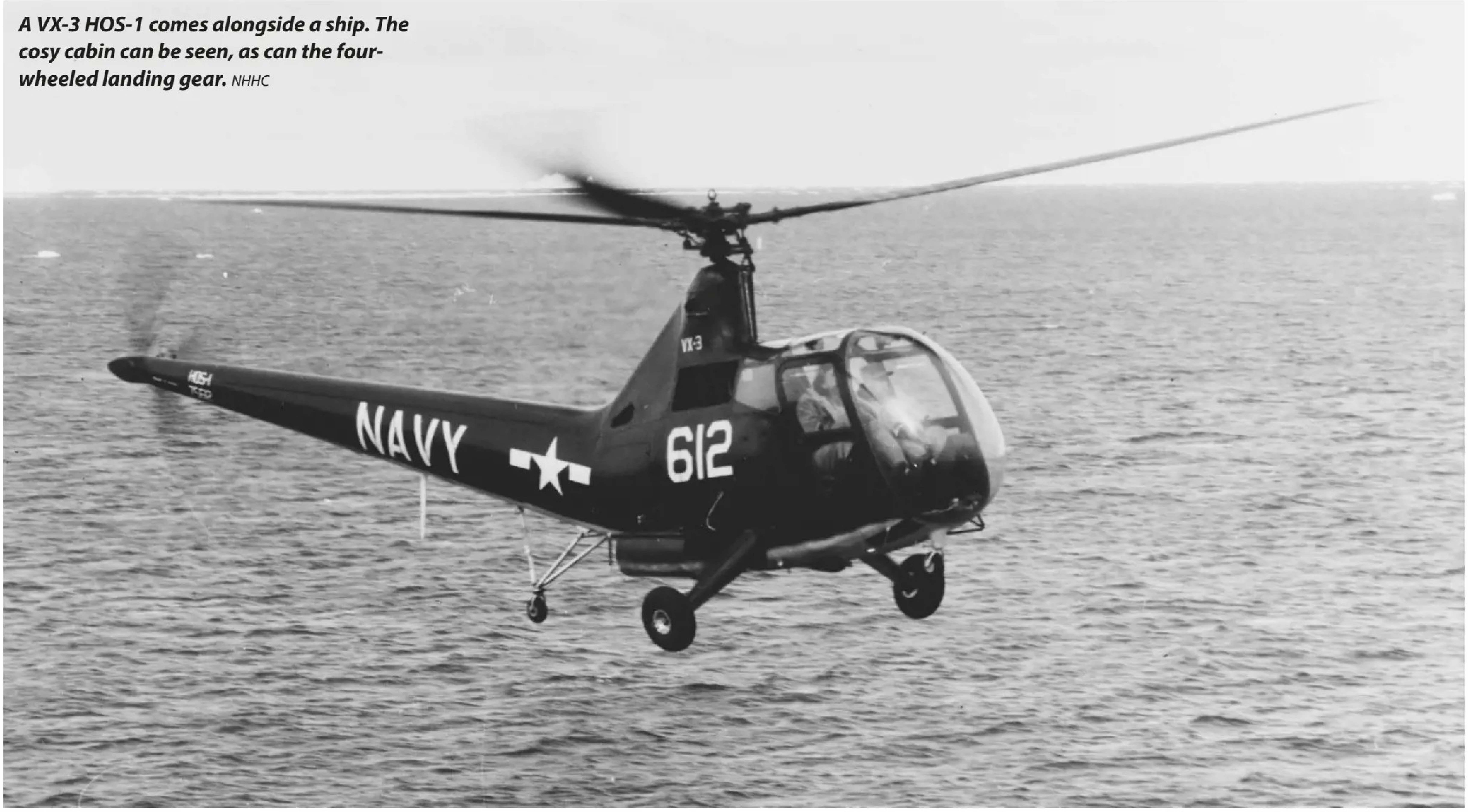
It was obvious that helicopters could be useful for spotting the fall of gunfire for battleships and cruisers and for hunting surface targets and submarines, tasks previously the domain of catapult-launched or land-based scout and patrol aircraft.

German Anton Flettner began experiments in the late 1920s and built his own gyroplane in 1935, followed up by helicopters with an intermeshing rotor design for the navy, including the Fl 265 which was operated from platforms on cruisers in the Baltic in 1939-40. The larger Fl 282 *Kolibri* (hummingbird) was used successfully from ships in the Mediterranean and Aegean for convoy protection duties from 1942. It proved reliable and stable even in bad weather and 1,000 were ordered by the Luftwaffe in 1944. Allied bombing destroyed the factories as they geared up for production, however, and only 24 prototypes and pre-production machines were completed. Some had open cockpits, while others had enclosed or semi-enclosed cockpits and a rearwards facing seat for an observer. The intermeshing rotor layout was adopted by U.S. company Kaman, who used it on aircraft including the H-43 Husky and K-Max.

The Focke-Achgelis Fa 330 *Bachstelze* (wagtail) was a very simple one-person gyrocopter designed to be towed by a surfaced U-boat, extending its search horizon reportedly as far as 30 miles (52km). The pilot used binoculars and reported his sightings with a telephone. The airflow generated by the vessel's speed would be sufficient to spin the unpowered rotor and the gyrocopter could be quickly folded and stowed away inside the submarine. Making its first flight on 6 June 1942 and entering service in early 1943, the Fa 330 was mainly used from Type IX D2 U-boats in the South Atlantic and Indian Oceans. On 5 August 1943, a *Bachstelze* autogyro spotted the Greek freighter *Efthalia Mari* east of Madagascar and directed *U-177* to sink it. A total of 112 were built, making it one of the most numerous rotorcraft of the war years. ■

Flettner Fl 282 V21

Crew: One or two
Fuselage length: 21ft 6in (6.56m)
Rotor diameter: 39ft 3in (11.96m)
Height: 7ft 3in (2.2m)
Empty weight: 1,676lb (760kg)
All-up weight: 2,204lb (1,000kg)
Powerplant: One Bramo Sh.14A 7-cylinder radial piston engine, rated at 160hp (119kW)
Max speed: 93 miles (150km/h)
Range: 186 miles (300km)
Service ceiling: 10,827ft (3,300m)
Armament: None



A VX-3 HOS-1 comes alongside a ship. The cosy cabin can be seen, as can the four-wheeled landing gear. *NHHC*

Sikorsky HOS-1/R-6

Stepping Stone

A transitional type, the S-49 was ordered in large numbers, but those built served mostly in obscurity before being replaced by more capable helicopters. It was the first to test dipping sonar for submarine detection.

Developed in parallel with the R-4 (S-47/VS-316A), the S-49 was a larger, more refined version with a metal-skinned fuselage. On 15 October 1943, its prototype, the Sikorsky VS-316B flew. It was powered by a a Lycoming O435-7 six-cylinder horizontally opposed engine rated at 225hp (165kW). All later examples, beginning with the XR-6A, had the slightly more powerful Franklin O-405 engine. For extra stability the R-6 had both a small nosewheel and a tailwheel.

Orders for 26 YR-6 development helicopters and a staggering 900 R-6As soon followed the first flight. Because Sikorsky's own plants were occupied with R-4s and R-5s most R-6s were built by Nash-Kelvinator in Detroit under government orders. After a slow start due in part to Sikorsky's reluctance to supply production drawings to a contractor, Nash-Kelvinator was rolling out 50 R-6s a month, but production was halted with the war's end after 219 had been completed.

Soon after the first flight the Navy requested three XR-6As from the USAAF under the designation XHOS-1, but these were not supplied until September 1944, initially serving with the Coast Guard. Most of the Navy's examples were allocated to experimental squadron VX-3 at NAS New York at Floyd Bennett Field, where they were used for around 18 months from July 1946. In 1947 one made the first transcontinental helicopter flight.

The R-6/HOS lacked a winch, but could lower a rope ladder for a person to climb up into the cabin, although this would have been difficult for a wet and cold survivor to use. The HOS-1 was used mainly for training, to acclimatise personnel to operating helicopters and with working with them.

Experiments were carried out to test the suitability of helicopters for anti-submarine warfare. In April 1945, an HOS-1 flew from a platform on the converted passenger ship USCGC *Governor Cobb* and dipped a sonar transducer into the sea and attempted to locate a nearby submarine.

One HOS-1 operated alongside an HNS-1 aboard the SS *Daghestan* as part of a transatlantic convoy and between the two helicopter types, 328 landings were successfully made in all weathers.

During the late summer of 1945, 25 R-6s were delivered to Britain as the Hoverfly 2. Of these, 15 were allocated to the Fleet Air Arm, but only four are believed to have entered service with No. 705 Squadron at RNAS Gosport, Hampshire in mid-1947, serving until 1950 without much distinction. ■

Sikorsky HOS-1

Crew: One and up to two passengers
Fuselage length: 33ft 11in (10.06m)
Rotor diameter: 38ft 0in (14.63m)
Height: 11ft 7in (3.35m)
Empty weight: 2,016lb (914.4kg)
All-up weight: 3,138lb (1,423kg)
Powerplant: One Franklin 0-405-9 piston engine rated at 235hp (165kW)
Max speed: 115mph (185km/h)
Range: 245 miles (394km)
Service ceiling: 13,200ft (4,023m)
Armament: Up to two 325lb depth charges

The take-off of a Hoverfly I on a damp September day in 1946 attracts a crowd of Royal Navy personnel.

Sikorsky R-4

The Hoverfly

The world's first truly practical helicopter, the R-4 had its limitations as a military machine, but pioneered many of the missions that would be developed by its successors.

Flown by Igor Sikorsky himself, the S-46 or VS-300 research machine made its first tethered flight on 14 September 1939. This was a very basic vehicle, consisting of little more than a tubular framework, a seat and a wheeled undercarriage. The configuration of a single main rotor and a tail rotor to control torque has since been used on the majority of helicopters, although the prototype had three tail rotors, two mounted vertically and one horizontally.

The Model VS-316A (S-47 or XR-4) first flew on 14 January 1942 and was accepted by the USAAF in May after successful demonstrations of its stability and control, including water landings on floats. The R-4 established the tradition of the helicopter pilot sitting on the right side of the cockpit, operating the cyclic control stick with the right hand and the collective with the left. Construction was based on an aluminium tube frame, with the rear fuselage covered in fabric. Zippers were sewn in to allow inspection and maintenance. The powerplant was a Warner R-550 radial engine mounted behind the cockpit. The rotor blades had a steel spar but were otherwise mainly plywood and balsa covered in fabric. It could lift little more than two people, and not carry them very far or very quickly, but it proved the concept of the helicopter for military use, and soon led to much more effective machines.

The new helicopter was involved in some notable mercy missions. Following the explosion of the destroyer USS *Turner* off New York in January 1944, an HNS-1 transported cases of blood plasma lashed to the helicopter's floats, to a New Jersey hospital, saving the lives of many survivors.

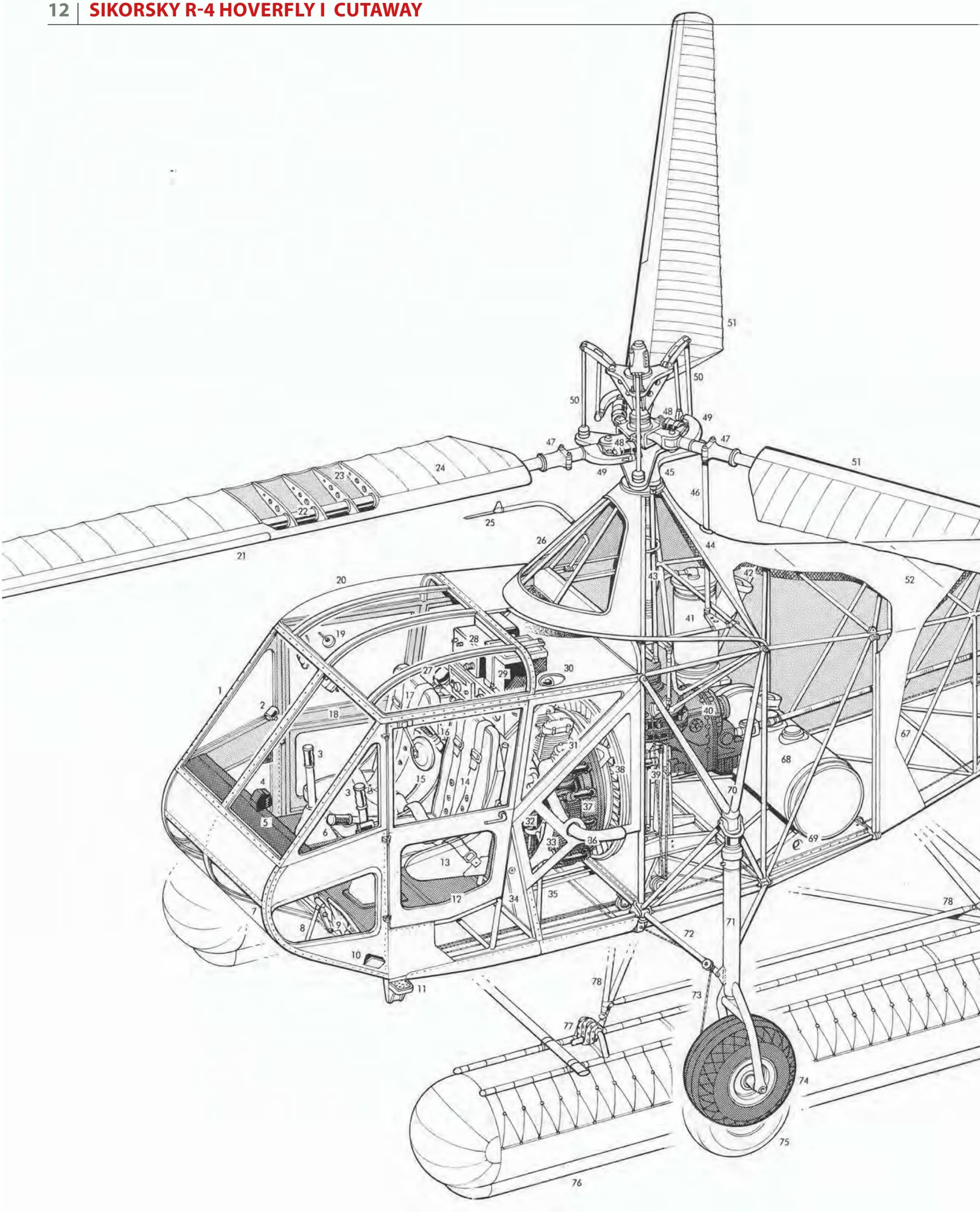
In April 1945 a Coast Guard HNS-1 rescued 11 survivors from a Canadian PBY Catalina crash in Northern Labrador. The helicopter was disassembled and carried from New York to Goose Bay inside a C-54 cargo aircraft

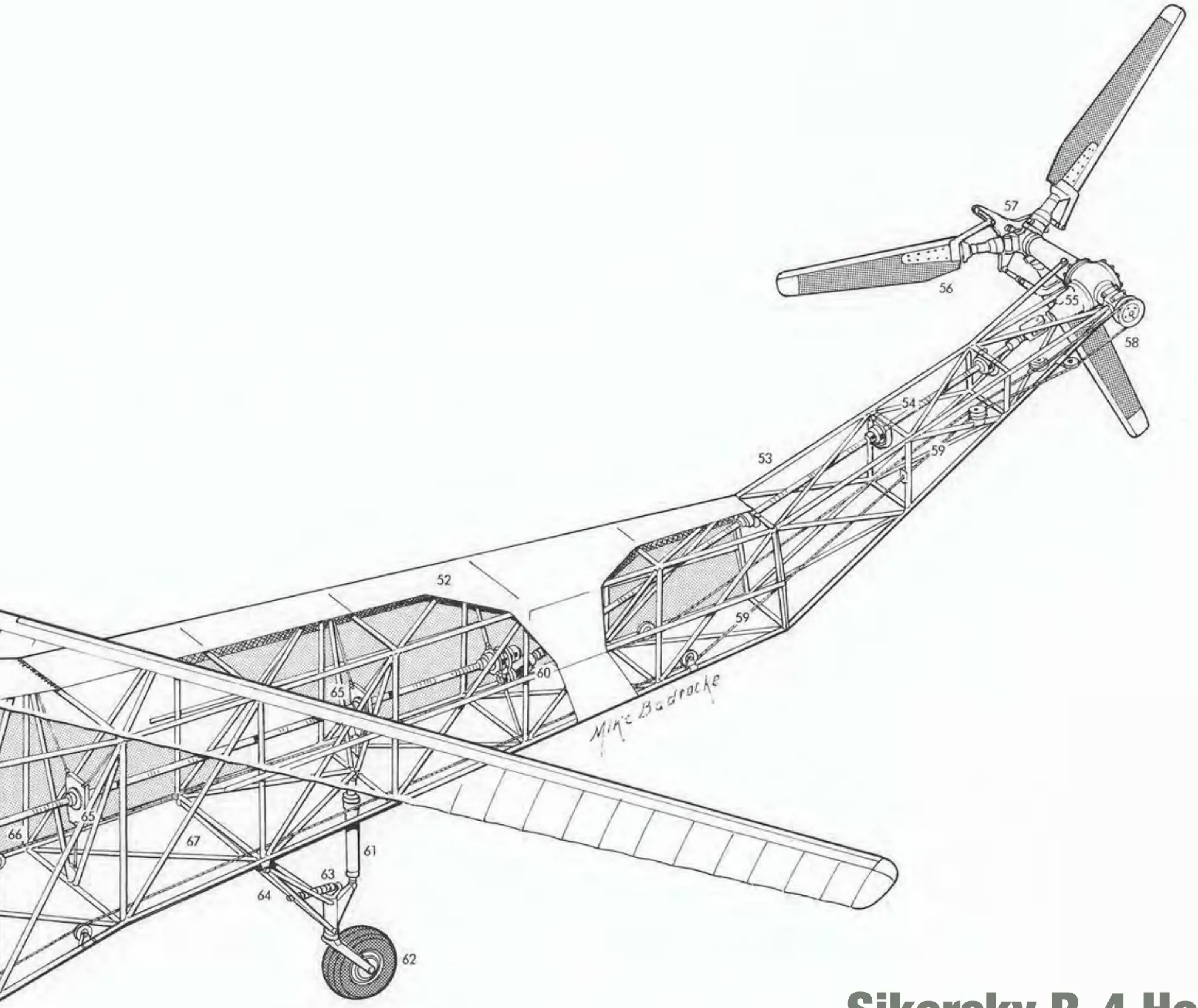
There were 100 production R-4Bs ordered under Army serial numbers. They were distributed to the USAAF (40), USN/USCG (19) and RAF/RN (41). Redesignated as an HNS-1, YR-4B Bu.No. 46445 became the first helicopter in the US Navy in October 1943. The US Coast Guard was more enthusiastic than the USN and led the way in overwater helicopter operations. Coast Guard HNS-1s also participated in Antarctic exploration from ships during Project High Jump in 1946-47.

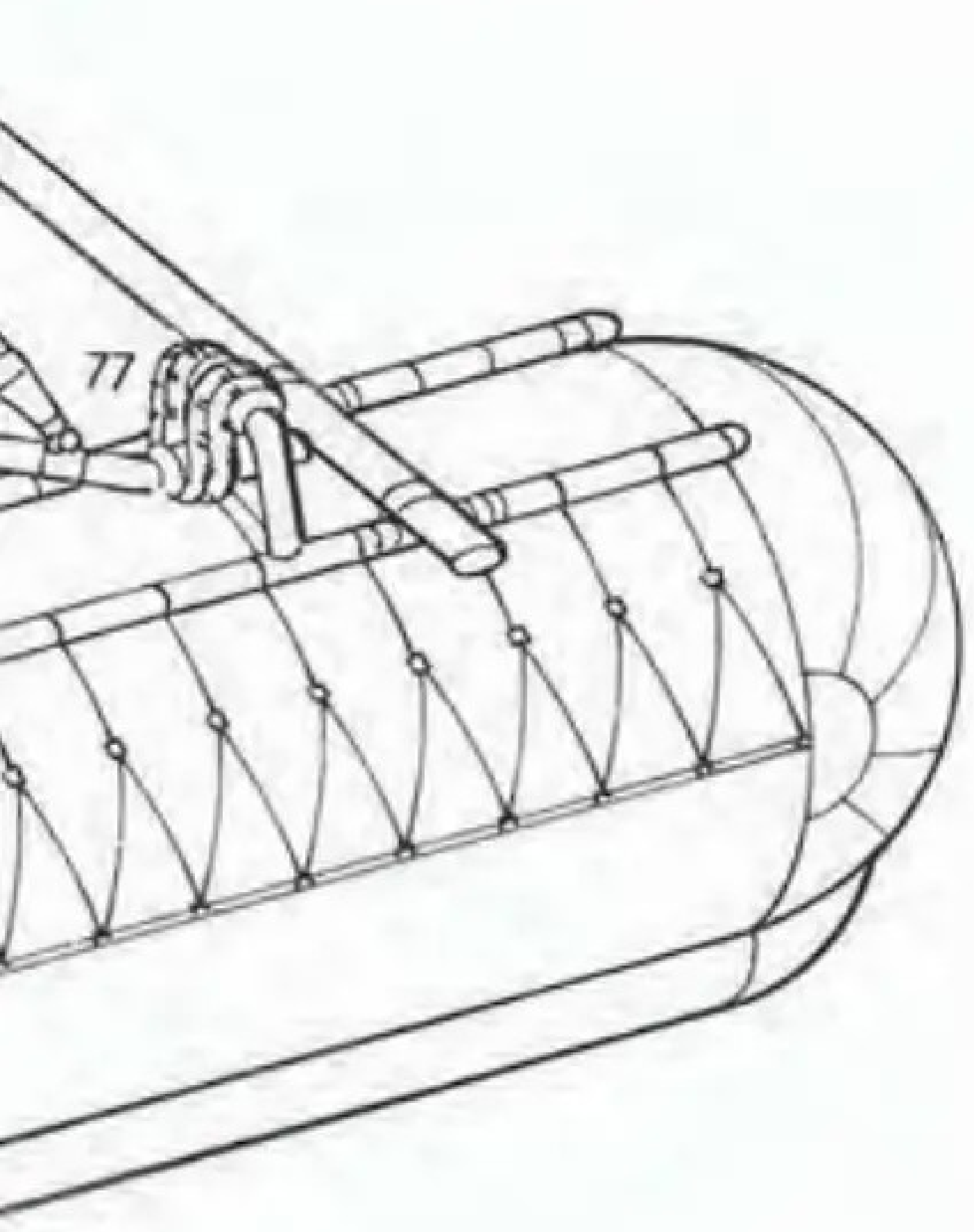
Britain ordered a total of 240 R-4Bs, which they dubbed the Hoverfly, but only 52 were delivered before the end of the war. The type was evaluated as an ASW patrol aircraft by Royal Navy pilots on the merchantman MV *Daghestan* in January 1944 during a transatlantic convoy. In August 1944 No. 529 Sqn became the RAF's first helicopter squadron and the same month the FAA's No. 771 Sqn began operations from Whetstone in the Orkney Islands, mainly using R-4s equipped with floats around the anchorage at Scapa Flow. ■

Sikorsky R-4B

Crew: Two
Fuselage length: 33ft 8in (10.26m)
Rotor diameter: 38ft 0in (11.6m)
Height: 12ft 5in (3.78m)
Empty weight: 2,008lb (913kg)
All-up weight: 2,537lb (1,153kg)
Powerplant: One Warner R-550-1 Super Scarab piston engine rated at 185hp (138kW)
Max speed: 75mph (130km/h)
Range: 130 miles (209km
Service ceiling: 8,000ft (2,440m)
Armament: None

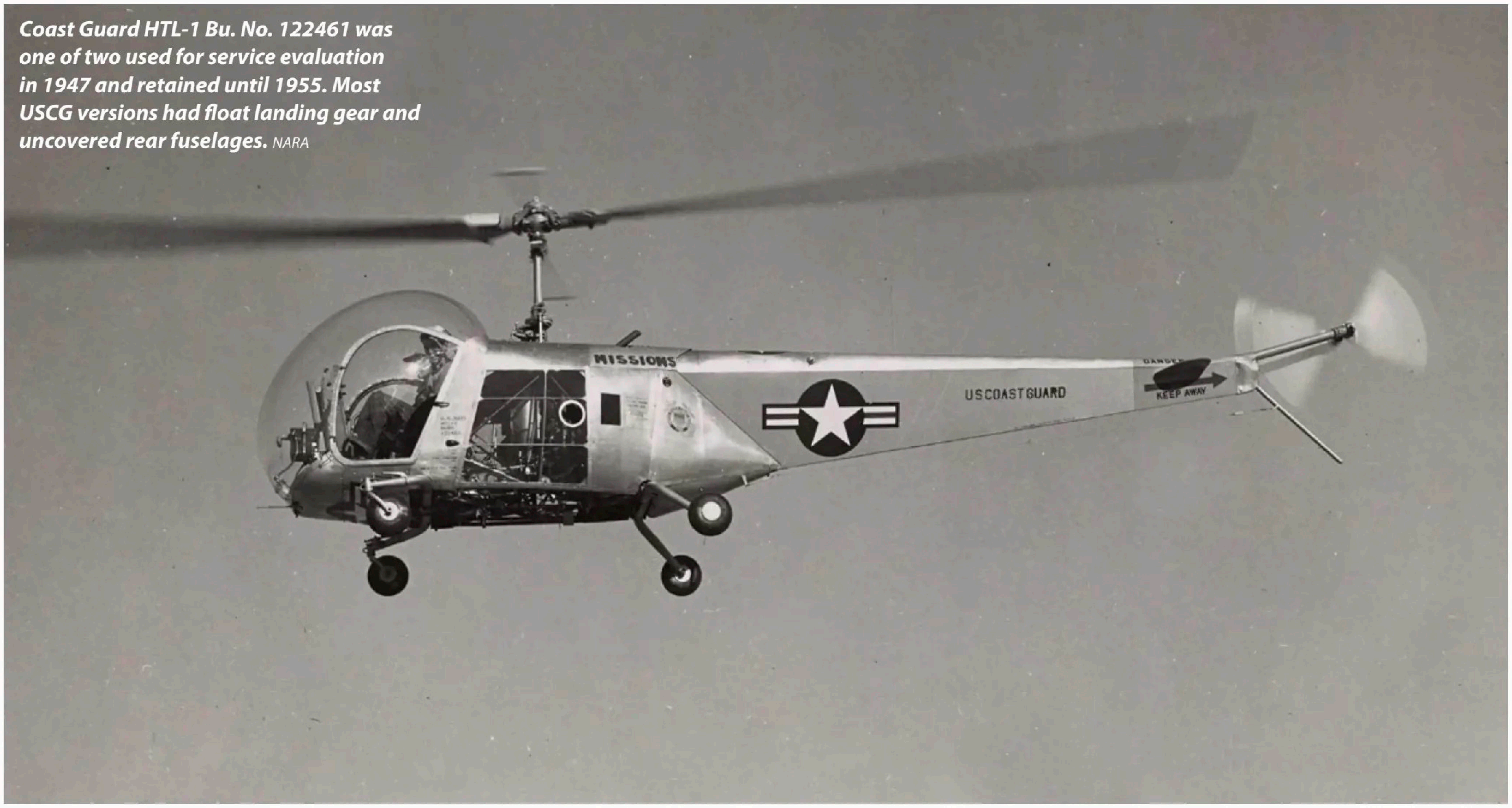






Sikorsky R-4 Hoverfly I

1 Windscreen panels
2 Instrument light
3 Cyclic pitch control columns
4 Stand-by compass
5 Instrument panel
6 Collective pitch lever with twist grip throttle
7 Downward vision windows
8 Brake lever
9 Yaw control rudder pedals
10 Cabin ventilator
11 Boarding step
12 Entry door
13 Pilot's seat
14 Safety harness
15 Rear view mirror, port and starboard
16 Rotor brake handle
17 Student pilot/observer's seat
18 Starboard cabin door
19 Temperature gauge
20 Cockpit roof glazing
21 Rotor blade steel leading-edge erosion sheath
22 Tubular steel blade spar
23 Rotor blade rib construction
24 Fabric-covered blade trailing edge
25 Pitot head
26 Engine cooling air intake
27 Fire extinguisher
28 Radio rack
29 Battery
30 Port navigation light
31 Sloping bulkhead
32 Engine mounting ring frame
33 Exhaust collector
34 Firewall
35 Underfloor control runs
36 Exhaust stub
37 Warner R-5550-1 seven-cylinder radial engine
38 Engine bay cooling air fan
39 Engine output shaft
40 Main gearbox
41 Oil tank
42 Oil filler
43 Main rotor mast
44 Rotor head fairing
45 Swash plate mechanism
46 Rotor head control rods
47 Blade root attachment joints
48 Drag dampers
49 Blade pitch control horn
50 Pitch blade links
51 Three-bladed main rotor
52 Rear fuselage fabric covering
53 Tail rotor pylon
54 Final drive shaft
55 Right angle gearbox
56 Three-bladed tail rotor
57 Rotor hub pitch control mechanism
58 Pitch control cable drive
59 Tail rotor cables
60 Intermediate transfer gearbox
61 Tailwheel shock absorber
62 Castoring tailwheel
63 Self-centering spring
64 Tailwheel mounting struts
65 Shaft bearings
66 Tail rotor transmission shaft
67 Fuselage welded steel tube space frame construction
68 Fuel tank
69 Fuel tank support members
70 Main undercarriage leg mounting truss
71 Shock absorber leg strut
72 Hinged radius rods
73 Brake cable
74 Port mainwheel
75 Mainwheel rebound position
76 Low pressure pontoons
77 Elastic cord shock absorber
78 Pontoon mounting struts



Coast Guard HTL-1 Bu. No. 122461 was one of two used for service evaluation in 1947 and retained until 1955. Most USCG versions had float landing gear and uncovered rear fuselages. NARA

Bell HTL and HUL Sioux

Utility, Observation and Training

Under many designations, the Bell 47 became one of the most recognisable military helicopters, particularly for its US Army service in Korea, but it was also used by the US Navy and Coast Guard and several other naval air arms.

Bell Aircraft's first helicopter, the Model 30, was an experimental single-engine machine with an open rear fuselage frame, a three-wheel undercarriage and a two-bladed wooden rotor. Larry Bell flew the first on 29 December 1942. The third example had three seats, a bubble canopy and a covered fuselage, and this aircraft, NX41962 the prototype of the definitive Model 47, flew on 8 December 1945. The US Army purchased 18 YR-13s in late 1946 and the US Navy acquired a batch of ten YR-13s for service evaluation as the HTL-1. They would eventually procure 187 examples of several different variants. The first of these entered regular service with Helicopter Utility Squadron HU-2 in April 1948. The 12 HTL-2s were equivalent to the civilian Model 47D. There were nine HTL-3s with a 200 hp (149 kW) Franklin 6V4-200-C32 engine, the HTL-4 had an uncovered tailboom and the HTL-5 used a Lycoming O-335-5 engine.

HTL-6 and -7 were models used by the US Navy for training. The -6 incorporated a movable elevator and the -7, was based on the Model 47J with a metal-skinned rear fuselage and a solid cabin door.

Coast Guard use began in 1946 with two HTL-1s acquired for multi-mission support in New York harbour. This included patrolling for smugglers and saboteurs.

Also based on the Bell 47J was the the HUL, a utility variant Two of the 28 procured in 1955-56 replaced the USCG's HTL-1's as HUL-1Gs. The HULs were largely used in Alaska and embarked for ice reconnaissance work aboard the Coast Guard's icebreakers. They also took part in early Deep Freeze Antarctic exploration missions.

In the 1960s HTLs/TH-13s were based at Naval Auxiliary Air Station (NAAS) Ellyson Field, Florida, serving as basic trainers. They also helped the Apollo astronauts prepare for the moon landings as the auto-rotation characteristics were comparable to the expected descent rate of the Lander as it approached the lunar surface. Some Navy H-13Ps remained in service until 1973.

HTL-4s and -6s served with the Royal Canadian Navy from in August 1951, mainly as trainers but also aboard RCN icebreakers for observation and photography.

Some of the 150 built by Westland at Yeovil for British forces under a licence from Agusta were used by the Royal Marines' 3 Commando Brigade Air Squadron (CBAS), although most were used by the Army Air Corps.

Agusta-built AB.47J-3s were used by the Italian Navy from 1958, some of them modified to carry a MK.44 torpedo for ASW work. The Japanese Maritime Self-Defense Force had 15 Kawasaki-built Model 47Ds and Gs in service from 1954, the last only retiring in 1995. ■

Bell HUL-1

Crew: One
Fuselage length: 32ft 5in (9.88m)
Rotor diameter: 37 ft 2in (11.33m)
Height: 9ft 4in (2.83m)
Empty weight: 1,618lb (734kg)
All-up weight: 2,800lb (1,270kg)
Powerplant: One Lycoming VO-435 piston engine rated at 200hp (149kW)
Max speed: 95mph (153km/h)
Range: 200 miles (322km)
Service ceiling: 17,000ft (5,182m)
Armament: None

MARINES
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Marines wounded at Kari San Mountain are carried to a HO3S for evacuation to a rear area hospital, 23 May 1951. *NHHC*

Sikorsky HO3S

Combat Rescue

Begun as a civil project, the S-51 became one of the first truly useful rescue helicopters, serving with all the branches of the US military.

With military budgets shrinking, Sikorsky looked to the civilian market. Developed from the S-48 of 1943, the S-51 prototype NX92800 flew on 16 February 1946. The test pilot was Dimitry D. ('Jimmy') Viner, who was Igor Sikorsky's nephew.

The S-51's aluminium-framed cabin had extensive Plexiglas glazing, while the fuselage was built of plastic-impregnated plywood and the tail boom was wood monocoque construction. There was a a three-bladed fully articulated main rotor and a three-bladed tail rotor. Originally the blades had metal spars, but were otherwise constructed of plywood and fabric. All-metal blades came along later during production and could be retrofitted to earlier aircraft. The prototype S-51 was demonstrated to the US Navy and made the first military rescue by a helicopter when two crewmen were picked up after a SB2C Helldiver crash off USS *Franklin D. Roosevelt* on 9 February 1947. Commercial operations with Los Angeles Airways commenced in October 1947, with the S-51 serving various locations from the roof of the main L.A. post office.

The US Navy purchased four HO3S-1s to support Operation High Jump, the first concerted American effort to explore Antarctica. These were the first helicopters to land on the frozen continent. More orders followed, eventually amounting to 88 examples for the Navy and Marine Corps.

Initial operations of five HMX-1 aircraft on the USS *Palau* in May 1948 proved slightly chaotic until deck crew and Marines learned to safely operate around helicopters. Although only capable of lifting three infantrymen, they proved the concept of delivering troops from ship to shore without the hazards of a beach assault

With VMO-1 in Korea the Marines' primary missions were liaison and observation, with the secondary search and rescue role taking on greater significance as the conflict progressed. VMO-6 rescued 23 crewmen from behind enemy lines in late 1950 alone.

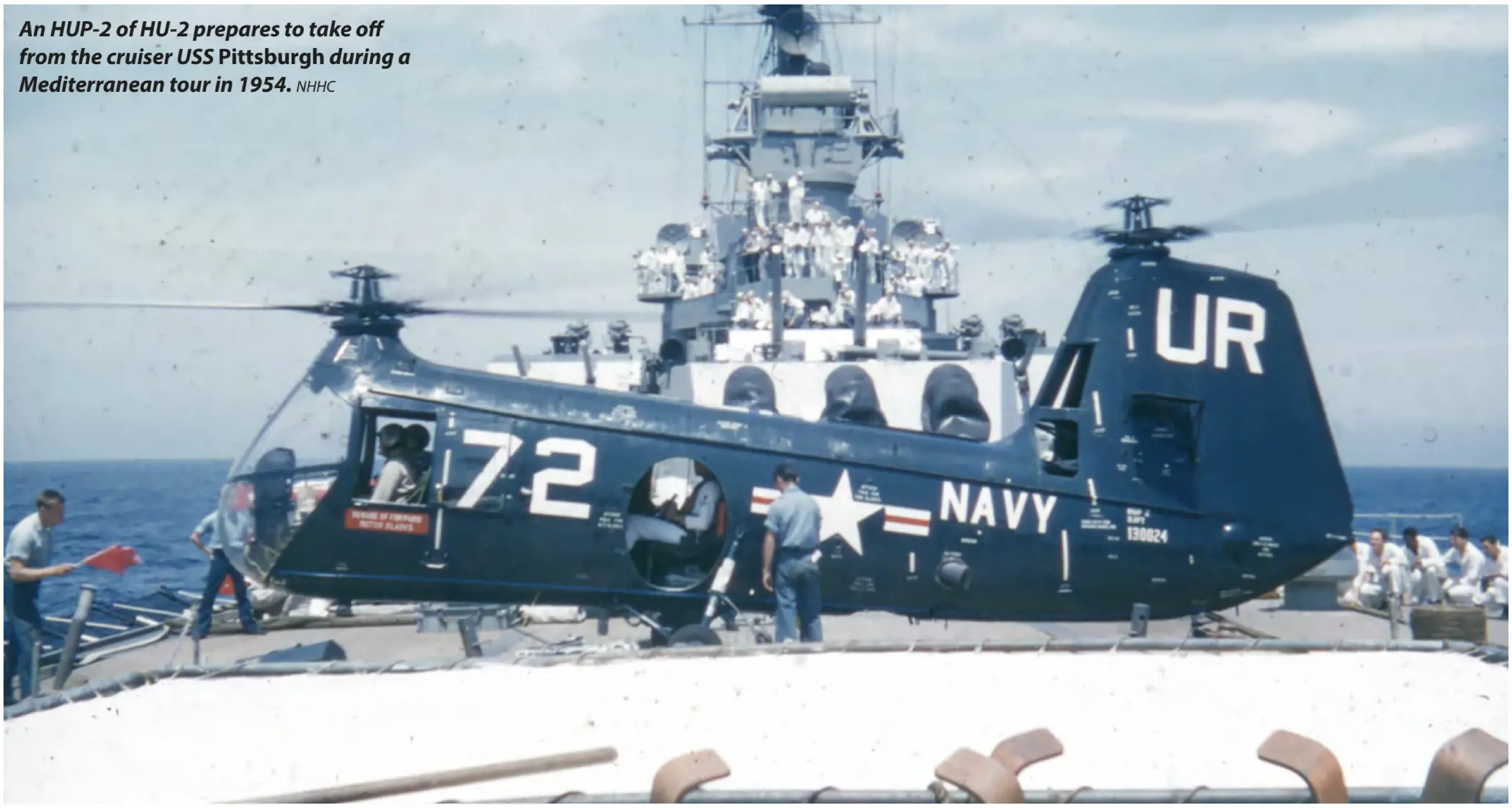
The Navy assigned its HO3Ss to helicopter utility squadrons HU-1 and HU-2. The HO3S performed plane guard duties from aircraft carriers, but made inshore and inland rescues when called upon, often operating from converted landing craft. Later in the war they searched for sea mines and spotted for naval guns.The type gained fame from its role in the 1954 movie *Bridges at Toko-Ri.* Lt (j.g.) John Koelsch of VU-2 became the first helicopter pilot awarded the Medal of Honor for his part in several daring rescues and his resistance as a prisoner of war.

As the H-5, the type also saw extensive service with the USAF, mainly in the rescue role. The Coast Guard operated the HO3S-1G equipped with floatation gear for use in the case of water landings.

Five S-51s were supplied to the Japanese Maritime Self Defense Force in 1954, for training and SAR duties. The type was built under license in the UK as the Westland Whirlwind, described separately. ■

Sikorsky HO3S-1

Crew: One or two; capacity for two or three passengers
Fuselage length: 57ft 1in (17.39m)
Rotor diameter: 48ft 0in (14.63)
Height: 13ft 0in (3.96m)
Empty weight: 3,650lb (1,656kg)
All-up weight: 4,900lb (2,222kg)
Powerplant: One Pratt & Whitney R-985-AN-5 Wasp Junior radial piston engine rated at 450hp (336kW)
Max speed: 103mph (166km/h)
Range: 245 miles (394km)
Service ceiling: 13,000ft (3,962m)
Armament: None



An HUP-2 of HU-2 prepares to take off from the cruiser USS* Pittsburgh *during a Mediterranean tour in 1954. NHHC

Piasecki HUP Retriever

Early Angel

The HUP was the first tandem-rotor helicopter with overlapping blades. Although of modest capabilities Its legacy can be seen in the CH-47 Chinook, which is still in production today.

The tandem rotor configuration was pioneered by Frank Piasecki of the Philadelphia-based Piasecki Helicopter Corporation. First of this type of rotorcraft to enter production was the HRP-1, known as the 'Flying Banana'. Powered by a single 600hp (448kW) Pratt & Whitney R-1840 radial engine, the HRP-1 had a fabric-covered fuselage and could carry up to eight survivors.

The US Coast Guard used three from late 1948 and returned two to the Navy in 1951-52. The HRP-2 formed the basis of the H-21A with a metal fuselage, widely used by the USAF

A 1945 competition for a plane guard and helicopter resulted in a fly-off at Patuxent River between the Piasecki Model PV-14 or XHJP-1 and the Sikorsky XHJS-1. As the PV-18 (HUP-1), the former was selected and a contract awarded in February 1946.

The HUP-1 prototype flew in March 1948 (the exact date seems to be lost to history), and production aircraft entered US Navy service early 1951 with HU-2.

HUP-1s had wooden rotor blades and a covering of balloon fabric over the rear of the engine pylon, which was non-structural. The short fuselage and folding blades allowed transport by deck elevator for hangar storage. Capacity was a pilot, co-pilot and up to five passengers or three casualty litters.

The HUP was employed on plane guard or 'Angel' duties, orbiting off the port side of the carrier during flight operations ready to rescue aircrew from the frequent mishaps in carrier operations of the time. A hatch in the floor allowed a winch cable to be lowered with a rescue collar or Stokes basket. The HUP's own engine was not very reliable. It produced little surplus power and in hot conditions the helicopter struggled to lift a pilot, crewman and a soggy survivor.

There were 32 HUP-1s built, followed by 165 HUP-2s, without endplate fins, some of which were fitted with AN-AQS-4 dipping sonar for anti-submarine warfare as the HUP-2S.

The HUP-3 utility transport version introduced an autopilot, the first to be installed on a production helicopter, although the system was regarded as somewhat unreliable. It was also said to be the first helicopter to perform a loop, unintentionally. There were 30 HUP-3s, three of which were supplied to the Royal Canadian Navy for land-based rescue use and operated from 1954-65.

France's *Aéronavale* operated 19 HUP-2s from 1953-1965 in the 'Pedro' carrier rescue role.

As the H-25A Army Mule, 70 were supplied to the US Army in 1951, 50 of which were returned to the Navy in the late 1950s. Surviving HUP-2s were redesignated UH-25B in 1962 and HUP-3s became UH-25Cs. ■

Piasecki HUP Retriever

Crew: Two or three
Fuselage length: 56ft 11in (17.35m)
Rotor diameter: 35ft 0in (10.67m)
Height: 12ft 6in (3.81m)
Empty weight: 3,928lb (1,782kg)
All-up weight: 6,100lb (2,767kg)
Powerplant: One Continental R-975-46 radial piston engine rated at 550hp (410kW)
Max speed: 105mph (169km/h)
Range: 340 miles (547km)
Service ceiling: 10,000ft (3,047km)
Armament: None

Dragonfly HR.3 WP497 flies over USS Saratoga circa September 1957. F3H Demons, F4D Skyrays and a HUP Retriever are visible on deck.

Westland Dragonfly

Rotary Rescuer

The Dragonfly was a derivative of the S-51 built under licence from Sikorsky and the first helicopter produced by Westland, which would go on to make many more helicopters of their own and other's designs.

The signing of a licence agreement on 10 January 1947 proved the beginning of the company's successful transformation into a helicopter manufacturer. Six S-51 pattern aircraft were delivered from Philadelphia to Yeovil and one was tested by the Royal Navy while they waited for the type to be anglicised, a process delayed by a lack of US dollars to buy some needed parts from America. The Sikorsky design was modified by installing a British Alvis Leonides engine. This turned in the opposite direction to the Wasp Junior, but a reverse gear was fitted in the engine fan/flywheel assembly to keep rotor rotation the same.

G-AKTW, the first Westland-built aircraft flew on 5 October 1948 in the hands of Lt Alan Bristow. An order for 13 aircraft for the Royal Navy followed and the first production Dragonfly HR.1 was delivered to No. 705 Squadron on 13 January 1950. This was the first operational all-helicopter squadron to form outside the USA.

HMS *Glory* arrived in Korean waters with its Dragonfly air sea rescue unit in April 1951 and soon rescued eight pilots, four of them from behind enemy lines. The type also operated from the carriers *Indomitable, Ocean* and *Sydney* during the conflict. During the 1950s, Dragonflies served with 15 air stations in the UK and Malta and aboard nine carriers.

Dragonflies aided in the rescue efforts during the severe flooding in the Netherlands in February 1952, rescuing more than 600 people during the course of two weeks and taking the Dutch King and Queen on tours of the affected areas.

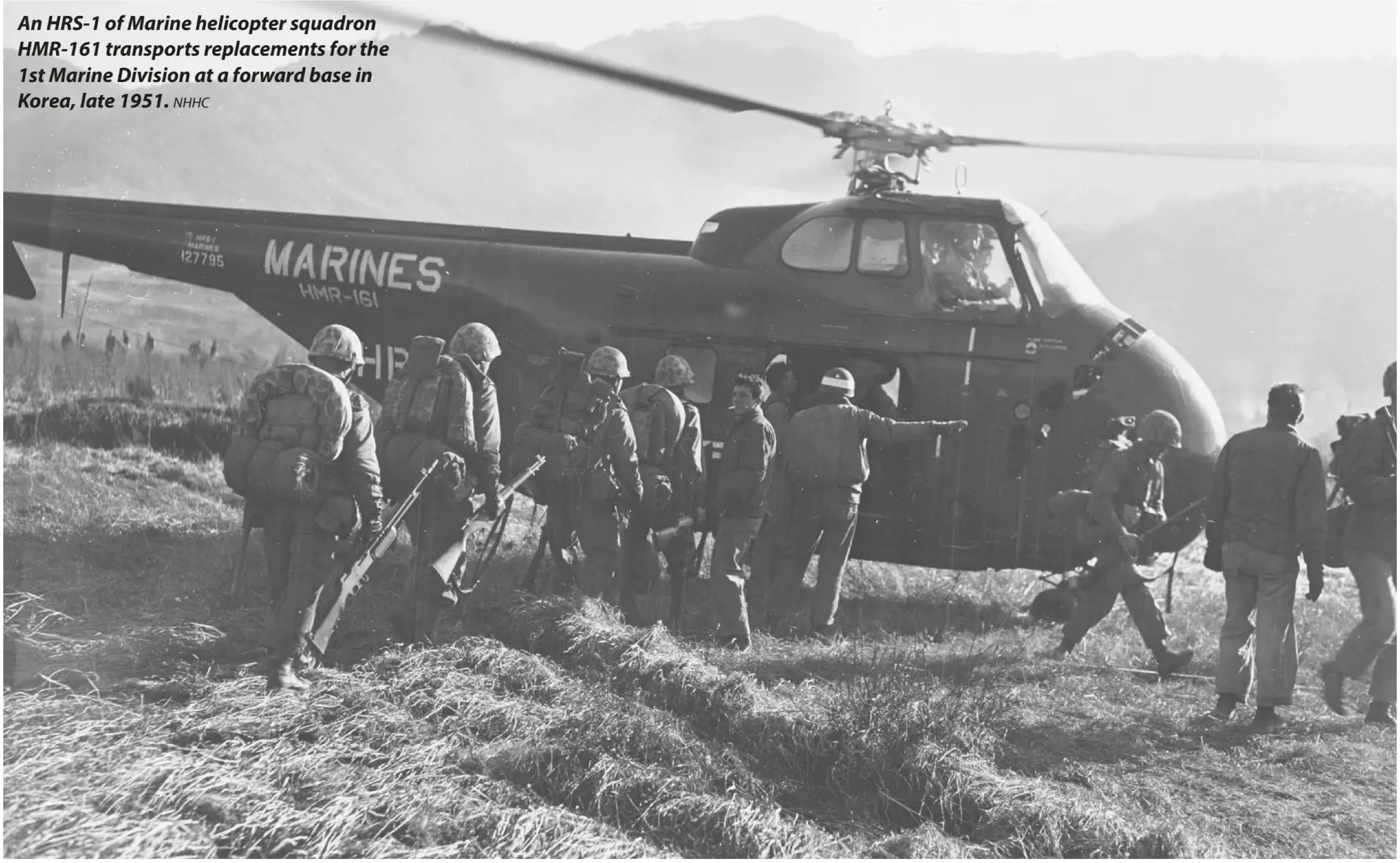
The Dragonfly HR.3 had all-metal rotor blades and hydraulic servo controls. Between 1957-1960, around 25-30 HR.1s and HR.3s were upgraded to HR.5s with modernised instrumentation and other minor improvements.

A total of 98 Dragonflies were supplied to British forces, 58 of them HR.3s. The RAF operated the Dragonfly HC.2 and HC.4 as a casualty evacuation helicopter.

A development of the Dragonfly was the civilian WS-51 Widgeon with the gearbox and rotor system of the S-55. Plans to convert 24 Dragonflies to Widgeon standard as Dragonfly HC.7s were dropped for financial reasons, although a pair of Widgeons was sold to Brazil's navy. The last Dragonflies wçere retired in 1967 from the Royal Naval College at Dartmouth where they had been used for giving air experience to officer cadets. ■

Westland Dragonfly HR.1

Crew: One or two; two or three passengers
Fuselage length: 57ft 7in (17.54m)
Rotor diameter: 48ft 0in (14.63m)
Height: 13ft 0in (3.95m)
Empty weight: 4,380lb (1,987kg)
All-up weight: 5,870lb (2,663kg)
Powerplant: One Alvis Leonides 50 radial piston engine rated at 540hp (403kW)
Max speed: 95mph (153km/h)
Range: 300 miles (483km/h)
Service ceiling: 12,400ft (3,780m)
Armament: None



An HRS-1 of Marine helicopter squadron HMR-161 transports replacements for the 1st Marine Division at a forward base in Korea, late 1951. NHHC

Sikorsky HO4S/HRS

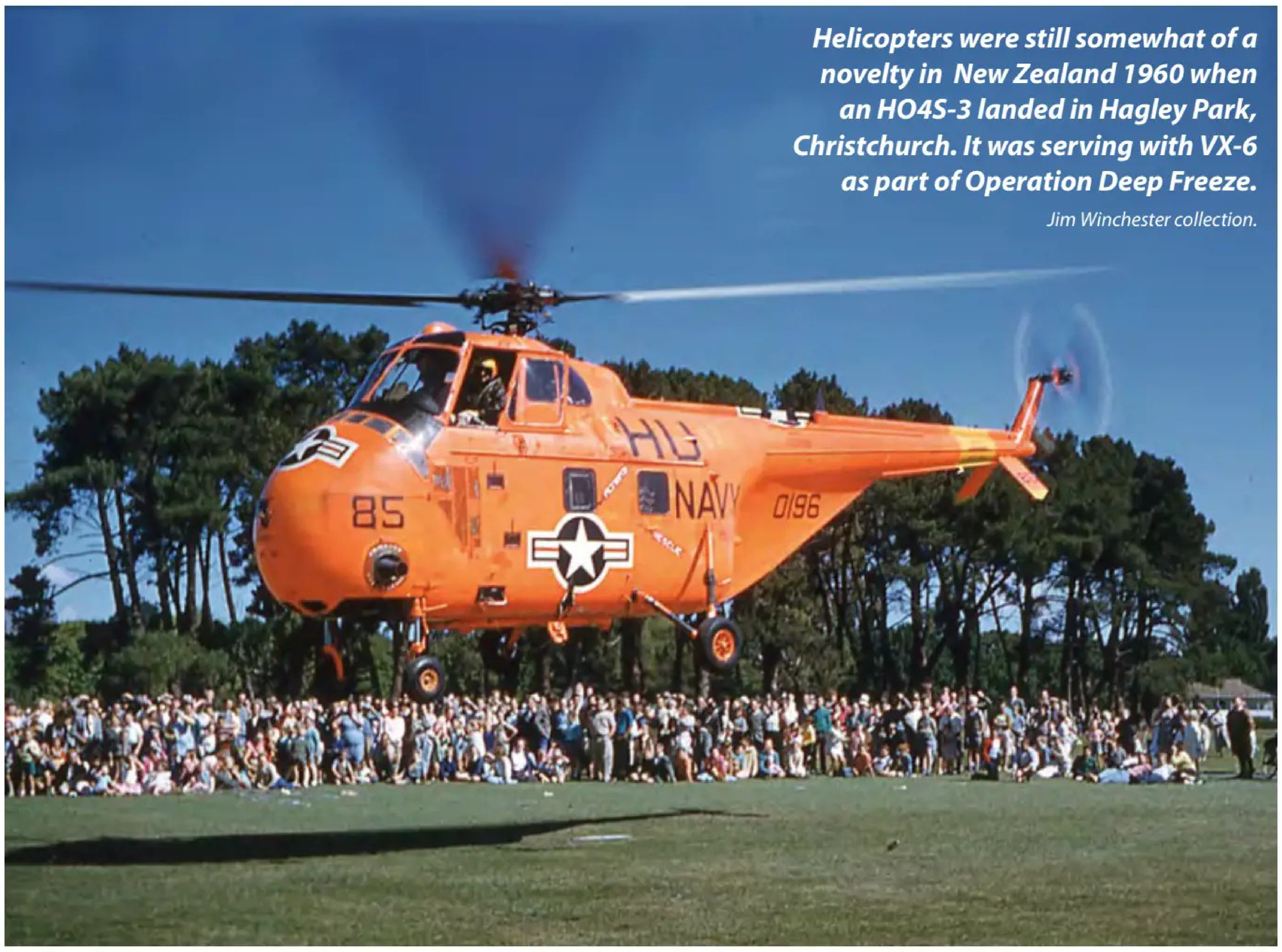
The 'Horse'

Although mainly associated with the Marine Corps, the HO4S was the first helicopter to be used in an anti-submarine role and performed many other missions for the USN and other navies.

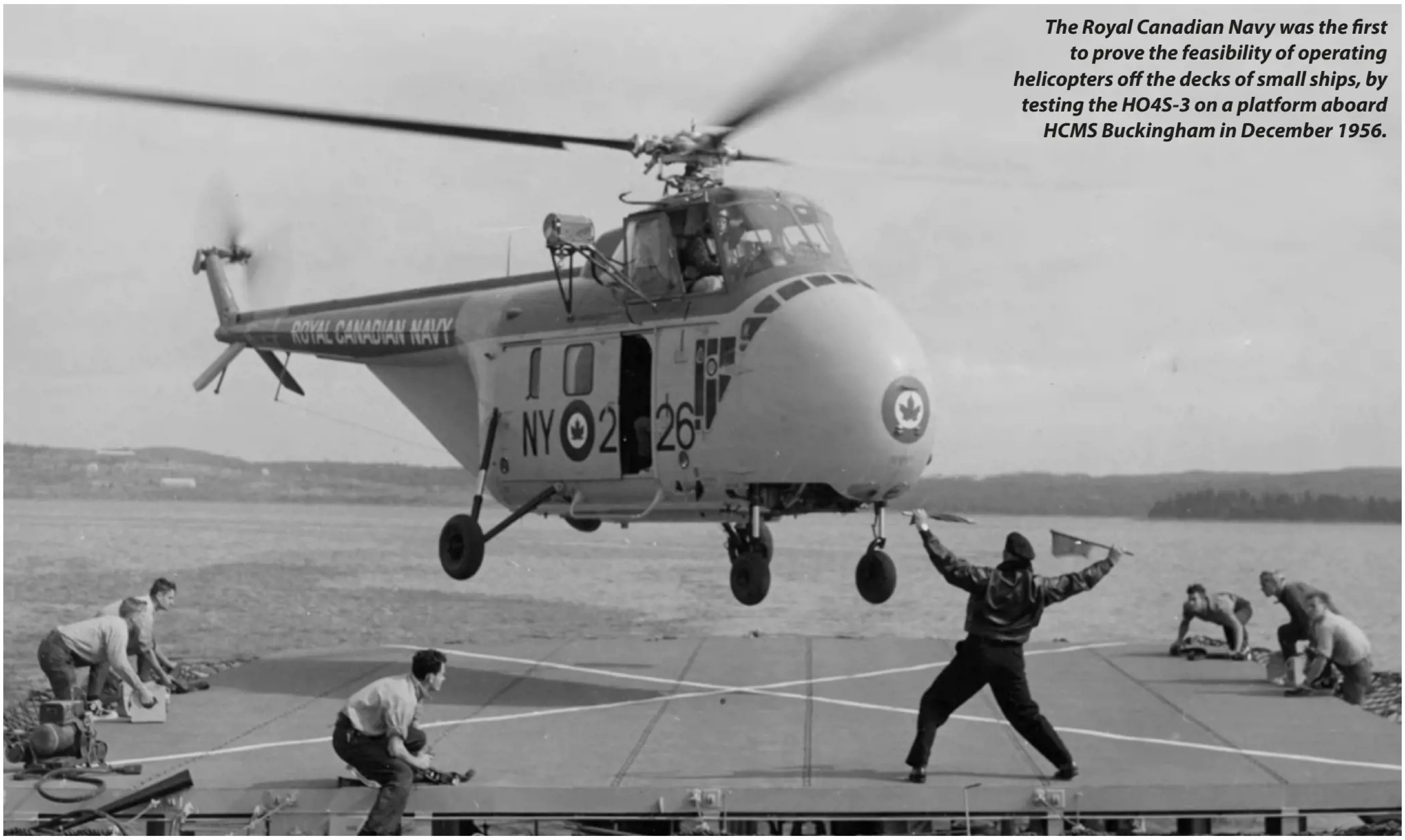
Developed as a private venture, Sikorsky's S-55 went from drawing board to first flight on 10 November 1949 when 'Jimmy' Viner flew 49-2012 at Sikorsky's plant at Bloomfield, Connecticut.

The S-55 was of conventional single-rotor configuration. Its innovation was placing the engine in the nose, ahead and below of the cockpit, which allowed for a spacious and unencumbered cabin. Clamshell doors allowed easy access to the engine for maintenance and an engine change could be accomplished in two hours. The rotor head assembly and gear box was another quick change unit that could be replaced in 3hrs. The HO4S-1 had a 550hp (410kW) Pratt & Whitney R-1340-57 engine. The HO4S-2 was powered by a 600hp (447kW) Wright R-1300-3.

Ordered initially by the USAF as the YH-19, the Navy and Coast Guard called the S-55 the HO4S



Helicopters were still somewhat of a novelty in New Zealand 1960 when an HO4S-3 landed in Hagley Park, Christchurch. It was serving with VX-6 as part of Operation Deep Freeze.
Jim Winchester collection.



The Royal Canadian Navy was the first to prove the feasibility of operating helicopters off the decks of small ships, by testing the HO4S-3 on a platform aboard HCMS Buckingham in December 1956.

and the Marine Corps, the HRS, leading inevitably to the nickname 'Horse'. The name Chickasaw was applied by the US Army to their CH-19s as part of their tradition of Native American nomenclature, although this seems to not have been adopted by the Navy or Marines.

USAF H-19As made the first transatlantic crossing by helicopter in August 1952. Navy utility squadrons HU-1 at San Diego and HU-2 at Lakehurst, New Jersey accepted the HO4S in 1952. The former unit deployed some aircraft to Korea, flying them off converted tank landing craft.

Marine squadron HMX-1 started taking deliveries of the HRS with troop seating and self-sealing fuel tanks in April 1951. During Operation Marlex-5 off the west coast of Korea on 1 September, HRS-1s made the first operational ship to shore troop lift. HMR-161 moved the first troops to fly to a combat objective by helicopter on 13 September. By the 1953 ceasefire more than 60,000 troops had been carried into battle by this one unit. Another mission was to relocate rocket launcher batteries, which kicked up a lot of dust on firing, to a new location before enemy artillery could respond. The engine power was marginal for operating at high weights in mountainous terrain, but HMR-161 did not lose any aircraft in combat.

The Navy bought ten HO4S-1s for the ASW mission, forming HS-1 'Seahorses' at NAS Key West. They were equipped with AN/AQS-4 dunking sonar. Unfortunately, in its original form the Sikorsky proved underpowered for anti-submarine work. The HO4S-3 with a 700hp (522kW) Wright R-1300 engine proved adequate, giving the Navy its first effective ASW helicopter, albeit in daylight and good weather.

For Antarctic support Navy HO4Ss flew from icebreakers from Operation Deep Freeze I in 1955-56 until Deep Freeze 1969 and with Antarctic Development Squadron VX-6 in Deep Freeze I and II. The HO4S pioneered helicopter support to the space programme, picking up the instrument capsule from the Discoverer III satellite in 1960 and supporting the manned Mercury programme.

Production by Sikorsky reached 1,281 S-55s, including 118 for the USN, 30 for the Coast Guard and 244 for the Marines. S-55s were also built under licence by Mitsubishi in Japan and Sud-Est in France. Foreign air forces operating H-19s also included Argentina, Guatemala, India, Pakistan, South Vietnam, Thailand and Taiwan. The Royal Canadian Navy used 13, beginning with three HO4S-2s purchased in 1952 for plane guard duties aboard HMCS *Magnificent*, then ten HO4S-3s in 1955 for ASW work aboard *Magnificent* and *Bonaventure*. In 1956 deck landings were conducted on a platform fitted to the destroyer HCMS *Buckingham* paving the way for the use of large helicopters from smaller surface ships, using the 'Bear Trap' system to secure the aircraft to the deck on landing. The HO4Ss were also used for land-based rescue work. One rescued 21 people and a cat and a dog from a sinking Liberian cargo ship in November 1955. In service, five RCN aircraft were written off before the type was retired in 1970. Japan's Maritime Self-Defence Force (JMSDF) flew 13 examples from 1954-70. The Royal Norwegian Navy used four H-19Ds, and the Royal Netherlands Navy operated three HOS-3s from 1953-59, flying them from the carrier *Karel Doorman*.

In late 1962 under the tri-service redesignation system the HRS-3 became the CH-19E, the HO4S-3, the UH-19F and the Coast Guard's HO4S-3G the HH-19G. ■

HO4S-3

Crew: Two; capacity for ten passengers
Fuselage length: 42ft 2in (12.86m)
Rotor diameter: 53ft 0in (16.2m)
Height: 13ft 4in (4.07m)
Empty weight: 5,045lb (2,288kg)
All-up weight: 7,500lb (3,402kg)
Powerplant: One Pratt & Whitney R-1300-3 radial piston engine rated at 700hp (522kW)
Max speed: 112mph (180km/h)
Range: 360 miles (579km)
Service ceiling: 10,600ft (3,321m)
Armament: One Mk. 43 torpedo or depth charge

Whirlwind XK934 was an HAS.7 assigned to HMS Tiger in July 1957. Its career was brief and it ditched into Lough Foyle in Northern Ireland in May 1958.

ROYAL NAVY
XK934
BEWARE OF TAIL ROTOR
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Westland Whirlwind

Piston to Turbine

The success of the Westland WS-51 led to an agreement for licence production of its successor.

Following signature of the deal on 15 November 1950, a pattern aircraft, G-AMHK, was imported to the UK to help establish production. A group of 25 ex-USN HOS4s was supplied under the Mutual Defense Air Program (MDAP) as the Whirlwind HAR.21 and equipped No. 848 Squadron, the Fleet Air Arm's first operational assault helicopter unit, from October 1952. The unit was soon dispatched to the Far East and transported troops during the Malayan Emergency until its disbandment in Singapore in December 1956.

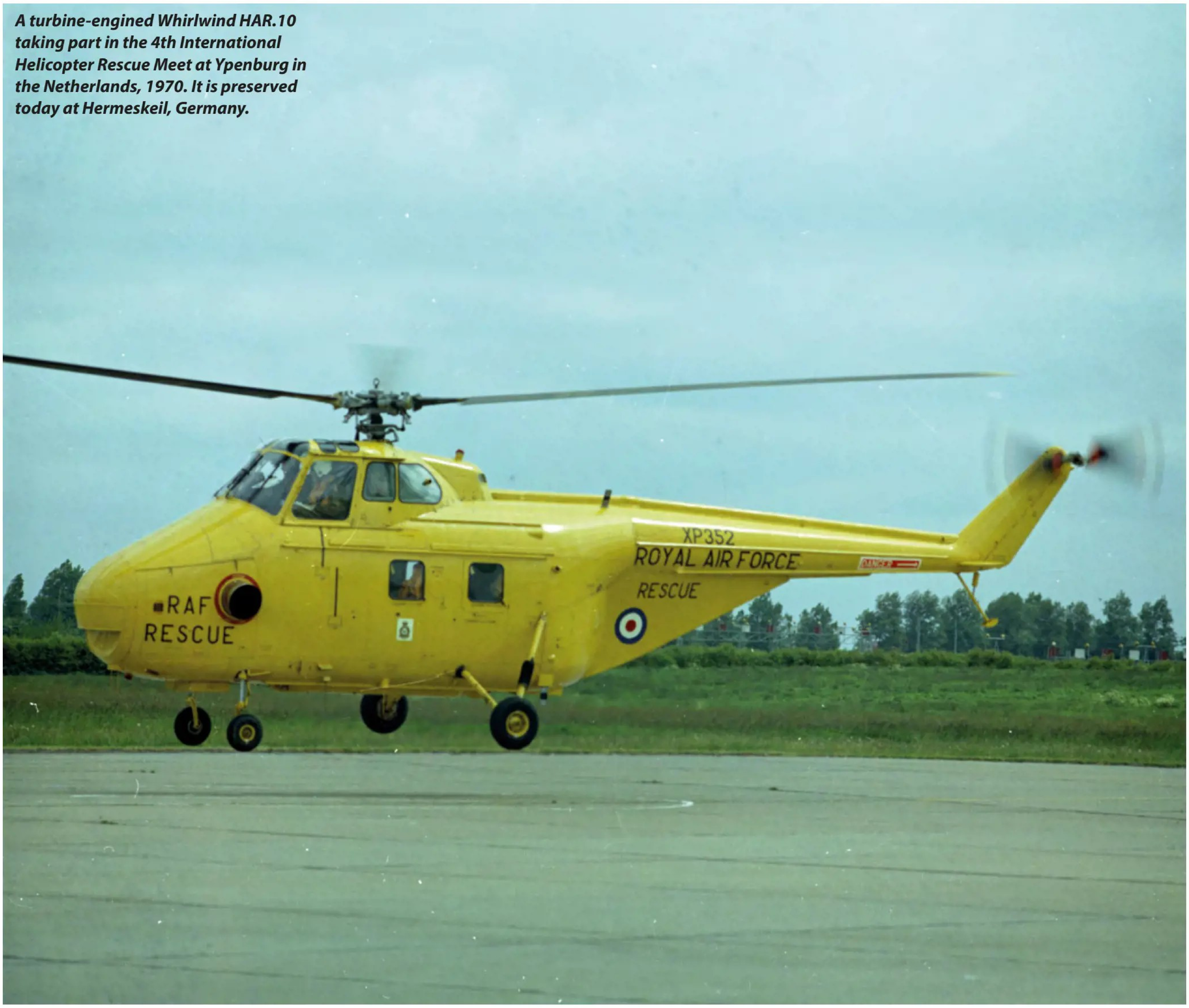
Changes between the S-55 and the WS-55 Whirlwind Mk. I, which retained the P&W Wasp engine, were minimal, although there were some gearbox modifications. The first Westland-built example flew on 12 November 1952.

Ten Whirlwind HAR.1s were delivered to the Royal Navy from July 1954 and joined No. 848 Squadron for SAR duties. Another 15 Sikorsky-built HO4S-3 were acquired in 1954 and issued to No. 845 Squadron as HAS.22s. Fitted with the AN/ASQ-4 dipping sonar, they were used to perfect ASW tactics, but also used in the assault role. During the 1956 Suez Crisis, HAS.22s ferried 45 Commando, Royal Marines from the carrier HMS *Theseus* to Port Said. No. 848 Squadron was reformed in Malta in October 1958 as the first Royal Marine Commando Helicopter Squadron, serving with 43 Commando in Cyprus.

XK991 Was a HAR.19 built for the Royal Air Force. It crashed in the sea during a winching practice in May 1963 when its rotors struck a boat's mast. *Leonardo*

The HAR.3. was powered by the 700hp (522kW) Wright R-1300 Cyclone engine and was used for the first vertical replenishment (vertrep) trials between a warship and Royal Fleet Auxiliary (RFA) support ship.

A major modification resulted in the Whirlwind HAS.7, which had a raised cabin floor to make space underneath for a torpedo bay and other ASW modifications. Usually they operated in



A turbine-engined Whirlwind HAR.10 taking part in the 4th International Helicopter Rescue Meet at Ypenburg in the Netherlands, 1970. It is preserved today at Hermeskeil, Germany.

pairs, with one searching for submarines with its dipping sonar and the other employing a homing torpedo when it a contact was detected. The Mk. 7 introduced the Alvis Leonides Major 755 radial engine of 750hp (559kW), but this had a troubled early life. Hovering at maximum power resulted in numerous engine and clutch failures and the variant was grounded for six months in 1959. Fixed-wing Gannet aircraft had to be brought back into service to cover the anti-submarine mission. Eventually, HAS.7s were reconfigured for the assault role and served in the Far East and carried on for this and training duties until 1976.

HAR.5s were Mk.3s with a modified tailboom and the Leonides engine, the Gnome-powered HAR.10 was an RAF SAR aircraft, the HCC.10 an RAF transport and the HCC.12 was a VIP variant used by the Queen's Flight.

Westland's licence agreement was expanded to allow the company to market the WS-55 to other customers

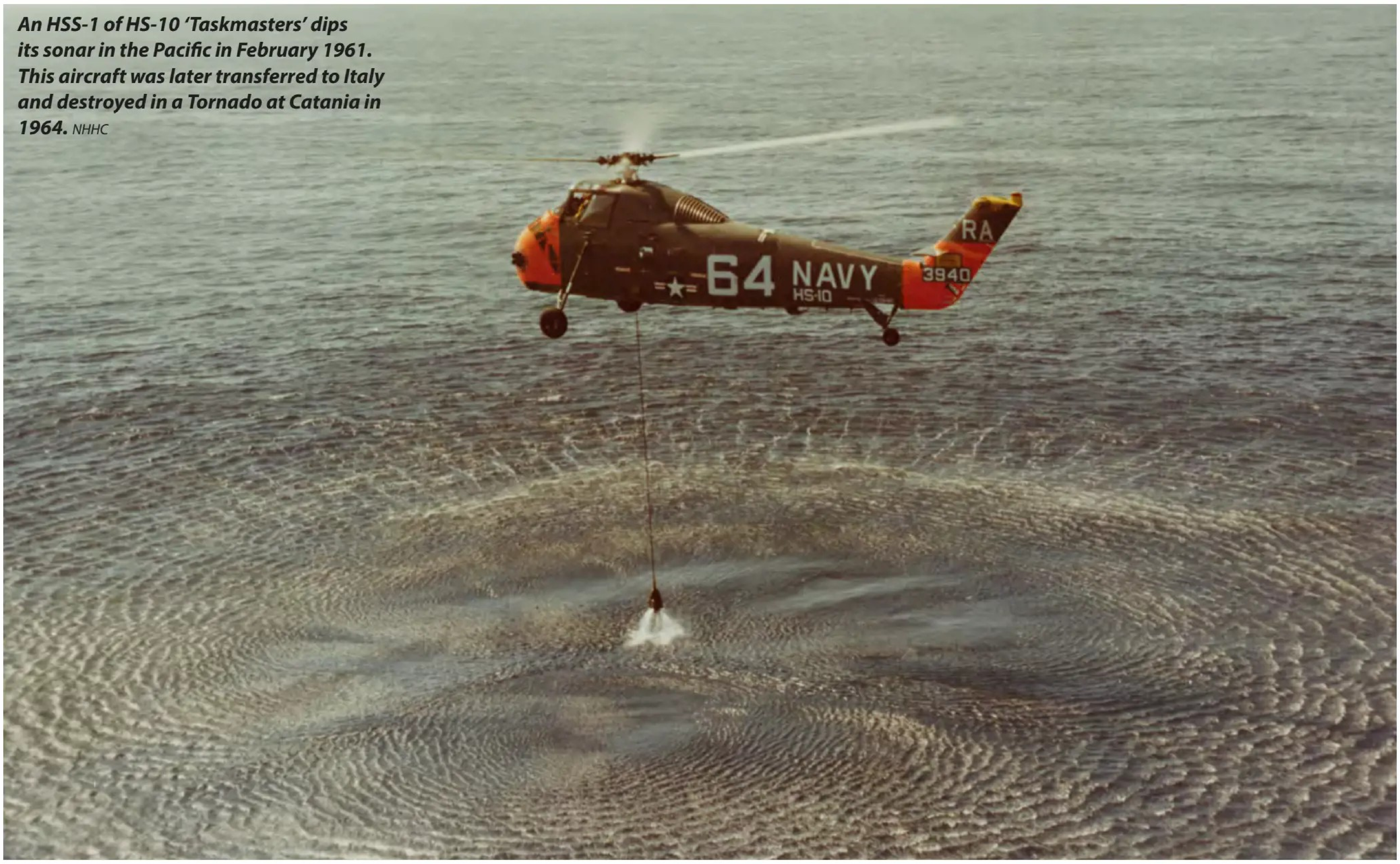
The Gnome-powered WS-55 Series 3 was exported to a number of civil and military operators, the latter including Austria, Jordan and Yugoslavia. Brazil's Navy operated five R-1340hp-powered Series 1 Whirlwinds from 1961, replacing them with five new Series 3s and two converted from Series 1s. They were used for transport and SAR aboard the carrier *Minas Gerais*, retiring in 1982.

The HAR.9 designation applied to 17 HAR.7s converted to turbine power with a Rolls-Royce Gnome H-1000 rated at 1,050shp (This was a licence-built version of the General Electric T58.

HAR.9s entered service in 1966 and were used aboard the ice patrol ships *Protector* and *Endurance* and SAR flights at Brawdy, Culdrose and Lee on Solent. They made one deployment as plane guards aboard HMS *Hermes* in 1966. In 1977 the Wessex HU.5 took over rescue duties. ■

Westland Whirlwind HAS.7

Crew: Two and up to ten passengers
Fuselage length: 41ft 9in (12.71m)
Rotor diameter: 53ft 0in (16.15m)
Height: 15ft 5in (4.69m)
Empty weight: 5,170lb (2,345kg)
All-up weight: 7,800lb (3,538kg)
Powerplant: One Alvis Leonides Major Mk.755 piston engine rated at 750hp (559kW)
Max speed: 110mph (176km/h)
Range: 334 miles (538km/h)
Service ceiling: Unknown
Armament: One Mk.44 homing torpedo or depth charges



An HSS-1 of HS-10 'Taskmasters' dips its sonar in the Pacific in February 1961. This aircraft was later transferred to Italy and destroyed in a Tornado at Catania in 1964. NHHC

Sikorsky S-58/HSS-1 Seabat/ HUS Sea Horse

'Huss', 'Dog' and 'Marine One'

Operated under many names and designations, the Sikorsky S-58 was last of the piston-powered military helicopters to enter widespread service. It performed missions from ASW to space capsule recovery and presidential transport.

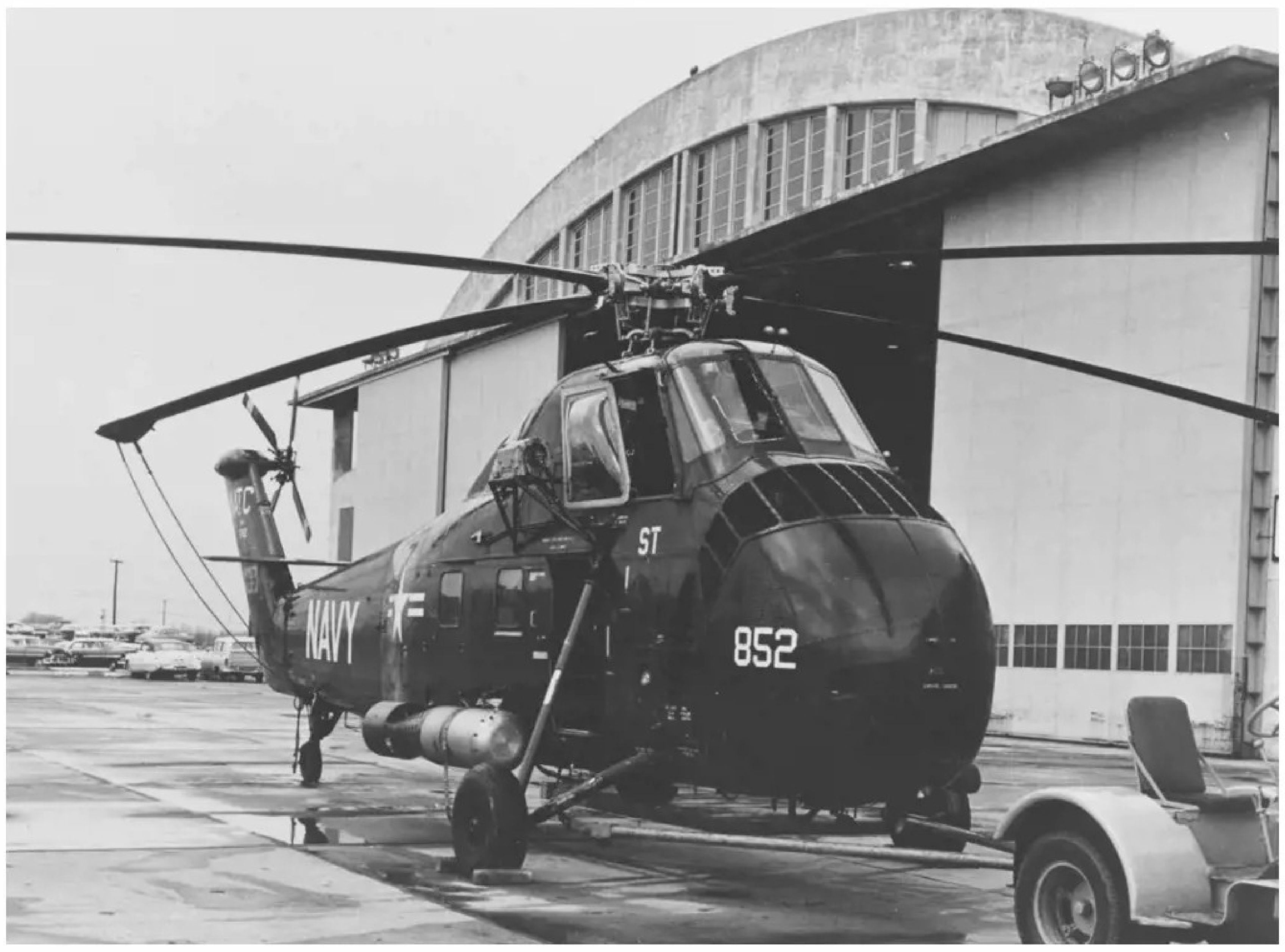
The HO4S (S-51) lacked range and carrying capacity, so using company funds, Sikorsky developed the larger, more aerodynamic S-58. The Navy initially preferred the Bell HSL and the Marines the S-56 (CH-37 Mojave), but problems with these programmes saw orders switched to the Sikorsky HSS.

First flight of the XHSS-1 was on 8 March 1954 and deliveries of the HSS-1 Seabat to HS-3 began in August 1955. The Army's CH-34 Choctaws began entering service a month later. The Marines ordered a utility version stripped of ASW equipment in October 1954, and service entry of the HUS Sea Horse with the Marines began in May 1957 with HM(L)-363. This later became the CH-34D, nicknamed 'Dog', although often called the 'Huss' from its pre-1962 designation.

As well as folding rotors, the tail section folded to allow carriage on aircraft carrier deck elevators. The nose wheel undercarriage of the HO4S was replaced by a tailwheel layout. As with the H-19, the engine was mounted in the nose with an angled transmission shaft running to a gearbox beneath the four-bladed rotor system. In the ASW role, the HSS featured Automatic Stabilization Equipment (ASE), which allowed it to hover accurately over a point during sonar dipping operations.

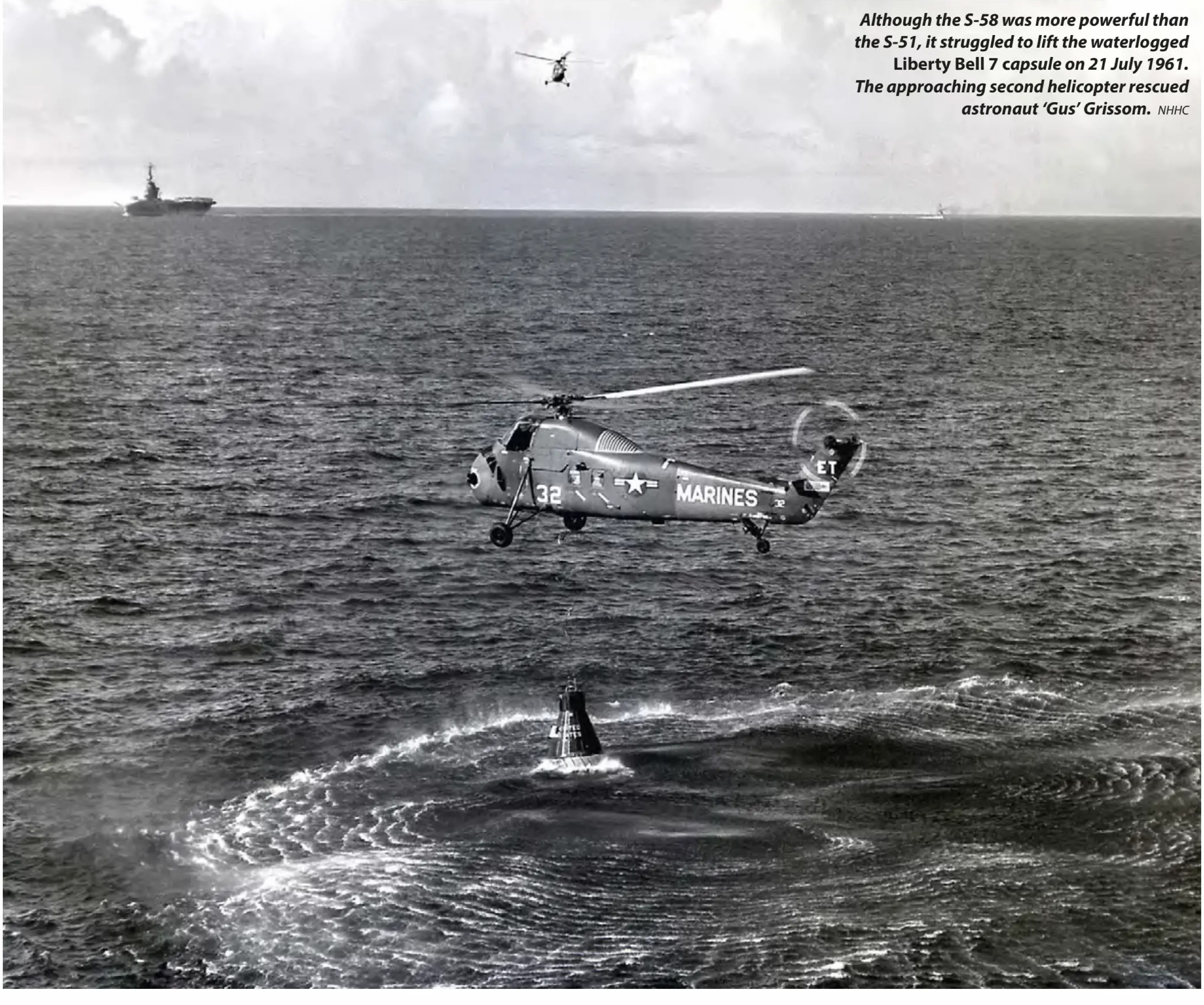
Able to carry 12 passengers or two tons of cargo, the HUS/CH-34 became the primary Marine assault transport until replaced by the CH-46. It was involved in many of the early US operations of the Vietnam War, and was depicted in the Stanley Kubrick film 'Full Metal jacket', although portrayed on screen by Westland Wessexes. The Marine variant flew from land bases and amphibious ships and occasionally from aircraft carriers. Some were armed with rocket packs and even SS-11 missiles to provide fire support and clear enemy strongholds before an assault. The Army used small numbers of UH-34s in southeast Asia, as did the South Vietnamese Air Force and the CIA airline Air America.

The HSS-1/HUS took over space support duties from the HO4S, recovering Mercury capsules and other hardware from ocean splashdowns. The Coast Guard acquired the HUS-1G as a replacement for the HO4S-1G in 1959. Of the six examples in USCG service, designated HH-34F after 1962, three were lost in accidents. The remainder were replaced by the Sikorsky HH-52A Seaguard from early 1963.

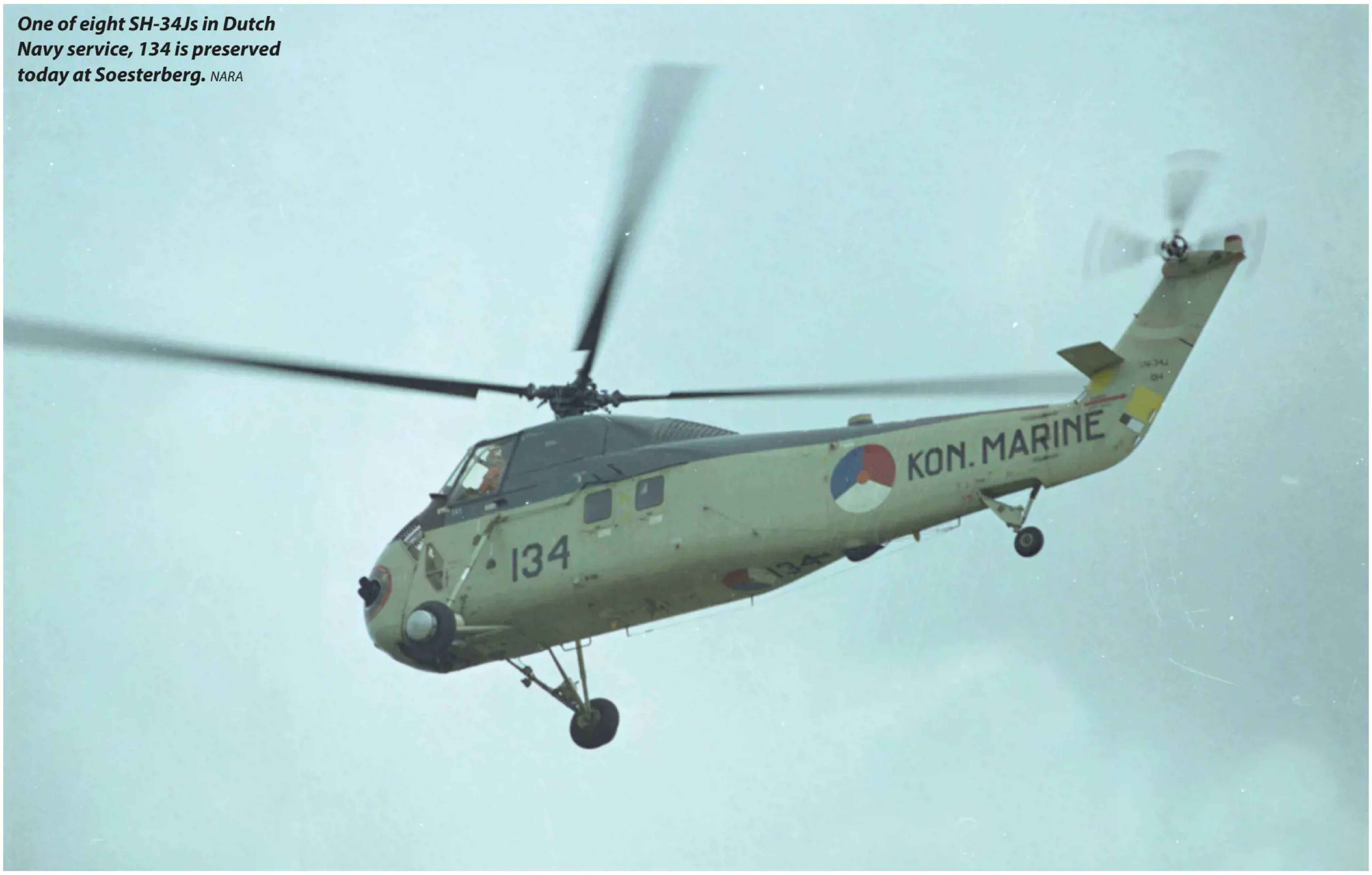


This HSS-1 of the Naval AIr Test Center (NATC) carries a Mk. 101 'Lulu' nuclear depth bomb with a yield of 11 kilotons. *NHHC*

President Eisenhower arrives aboard the cruiser USS **Des Moines** ***at Athens on 15 December 1959. The HSS-1 has flotation bags on the undercarriage.*** *NHHC*



Although the S-58 was more powerful than the S-51, it struggled to lift the waterlogged **Liberty Bell 7** ***capsule on 21 July 1961. The approaching second helicopter rescued astronaut 'Gus' Grissom.*** *NHHC*



One of eight SH-34Js in Dutch Navy service, 134 is preserved today at Soesterberg. *NARA*

VX-6 operated 11 examples of the HUS-1L (LH-34D) for Antarctic operations from 1960 to 1971, two of which were written off. A few retired HSS-1s were taken out of storage and issued to Air Force Reserve rescue squadrons as HH-34J Chocktaws in 1972. As an interim type, they were retired in 1974, becoming the last of the series to fly with the US armed services.

The H-34 was the first helicopter to regularly carry the US president. After Dwight Eisenhower became the first to fly in any helicopter (an H-13J) in 1957, it was decided a faster and more comfortable machine was needed. From 1958 both the Army, with the VH-34C Choctaw and the Marines with the essentially identical HSS-1Z Sea Bat, shared the executive transport mission. Sometimes the president would arrive on 'Air Force One' at Andrews AFB and have both 'Army One' and 'Marine One' waiting to take him to the White House. This duplication ended in 1976, by which time the VH-3 Sea King was in service with VMX-1, which took over the mission. The Navy purchased a few utility versions as the UH-34G and the UH-34J. The Seabat/Sea Horse was retired by the Navy and the Marines in March 1974.

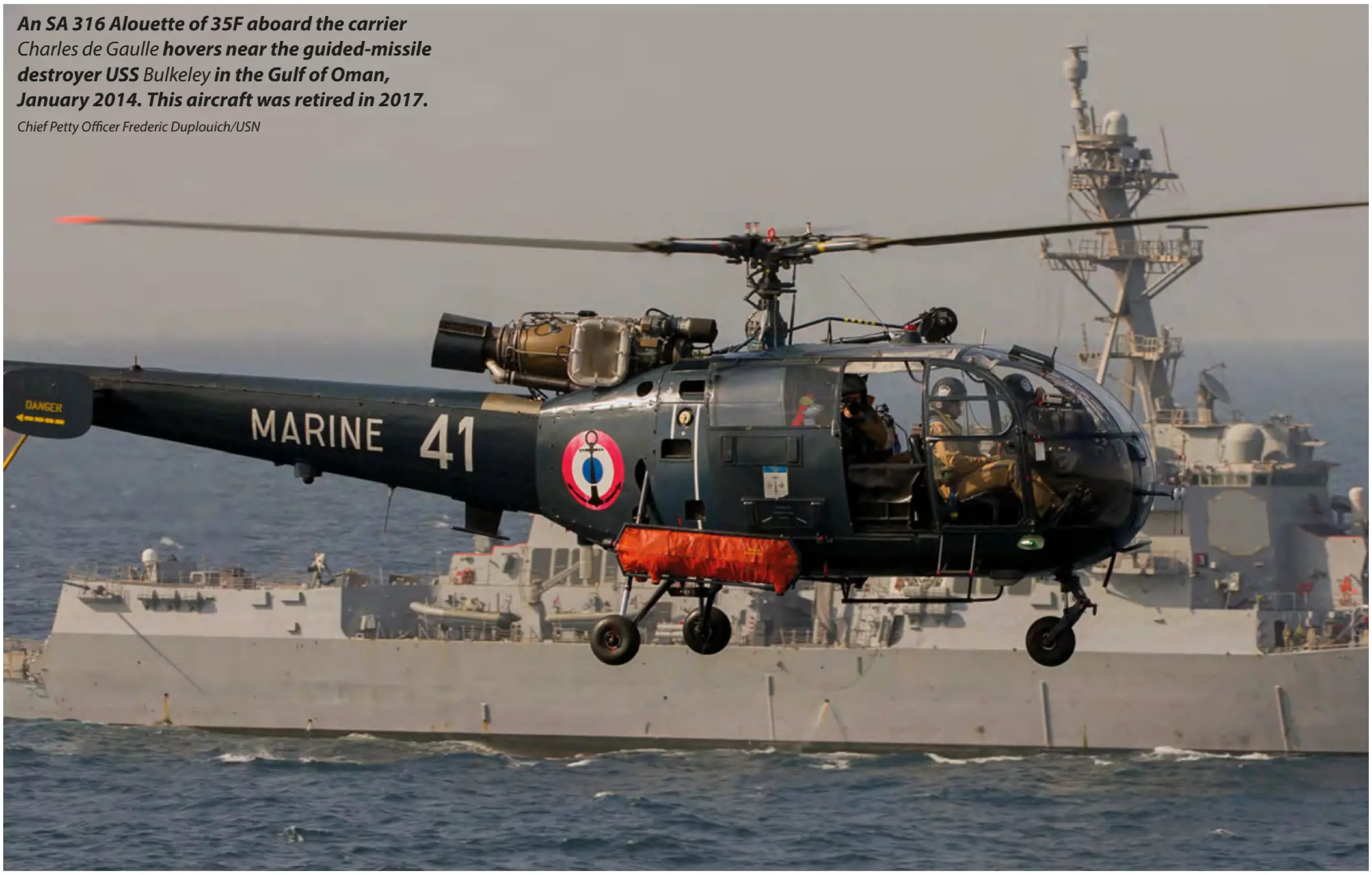
The S-58 was widely exported, with several nations operating them in maritime roles. Sud-Aviation at Marignane built 166 S-58s, 61 of them HSS-1s for the *Aéronavale*. They served as transports with three Flotilles in Algeria, some of them armed with cannon for fire support missions. The threat from Soviet submarines saw greater concentration on the ASW role, and two Flotilles were equipped with sonar- and torpedo-equipped aircraft. Initially this was the AQS-4 and Mk 43, respectively, with a 1969 modernisation introducing the DUAV-1 sonar and Mk 44 torpedo. The French HSS-1 also used the Mk 54 depth charge. Adopting the HSS-1 for use as a minesweeper was considered but rejected due to a lack of power. Flotation gear was added after a number of engine failures in the late 1960s. The type was phased out from Aéronavale service in 1979.

The Marineflieger operated 22 of the 145 H-34Gs in German service and some H-34Js. Land-based unit MFG-5 flew them mainly for SAR duties, but five were later converted to SH-34J ASW configuration. In 1960 five HSS-1Ns were supplied to the Royal Netherlands Navy, followed by seven more by 1963. Of the 12, six were written off in crashes. They served on the carrier HNLMS *Karel Doorman* in the ASW and utility roles.

The HSS-1N (SH-34J) was fitted for night operations equipped with a Doppler APN-97 radar to allow accurate hovering. Italy operated 11 SH-34Js and three H-34G transports. A storm in the autumn of 1964 destroyed six of the aircraft at Catania, Sicily. Uruguay's navy had six SH-34Js in service from 1971-1992 and Chile's two served from 1962 until 1978. Argentina's navy flew a single HSS-1 from 1957 until 1961 when it was lost in an accident. Japan operated eight Mitsubishi-assembled HSS-1s and nine HSS-1Ns from 1958-1975 as the JMSDF's first true ASW helicopter. The S-58 became the basis of the Westland Wessex, described separately. ■

Sikorsky HUS-1

Crew: Three, capacity for up to 12 passengers
Fuselage length: 49ft 9in (14.25m)
Rotor diameter: 56ft 0in (17.07m)
Height: 15ft 11in (4.85m)
Empty weight: 7,750lb (3,515kg)
All-up weight: 14,000lb (6,350kg)
Powerplant: One Wright R-1820-84 radial engine rated at 1,525hp (1,137kW)
Max speed: 123mph (198km/h)
Range: 185 miles (300km)
Service ceiling: 9,500ft (2,895m)
Armament: (HSS-1) two Mark 43 torpedoes or depth charges; 'Lulu' nuclear depth bombs; door-mounted machine-gun



An SA 316 Alouette of 35F aboard the carrier *Charles de Gaulle* ***hovers near the guided-missile destroyer USS*** *Bulkeley* ***in the Gulf of Oman, January 2014. This aircraft was retired in 2017.***

Chief Petty Officer Frederic Duplouich/USN

Aérospatiale Alouette III

Lark Ascending

The widely used Alouette III served on naval duties for many years and and continues in use today. It is one of the few naval helicopters to sink an enemy ship in combat.

The open-fuselage Alouette (lark) II with a skid undercarriage sold to more than 45 nations. Although well regarded, its users wanted more power and carrying capacity. Sud-Est – later Aérospatiale – developed a wheeled version with a semi-monocoque fuselage and an enclosed cabin able to carry up to seven people. Powered by a 570shp (425kW) Turboméca Artouste IIIB engine, the prototype SE 3160 Alouette III, F-ZWVQ, flew in the hands of Jean Boulet and Robert Malus on 28 February 1959. The designation was revised to SA 316A in 1968 when the improved SA 316B replaced it in production. The SA 319B introduced the Astazou engine in 1969.

A total of 37 of both types were used by the Aéronavale. Most were SA 316Bs used for utility, SAR and training missions, but one

***One of Pakistan's SA 319Bs lands aboard the carrier USS* George H.W. Bush *in the Arabian Sea in September 2011. The helicopter of 333 Squadron was assigned to the destroyer PNS* Shahjahan.** *MC3 Billy Ho/US Navy*

Belgium's three Alouette IIIs were in service from 1971-2021. SA 316B 1816/M-2 was flying off BNS Godetia during Nato exercise Trident Juncture off Norway in 2018, but is now stored for museum use at Beuavechain. *WO Fran C. Valverde/Nato Marcom*

Flotille, 34F, was established in 1974 with SA 319s optimised for ASW with SFENA auto stabilisation and ORB 31 surveillance radar. These could carry two Mk. 44 torpedoes or one torpedo and a lightweight MAD system. The Alouette deployed with the carriers *Clemenceau*, *Foch* and *Charles de Gaulle*, acting as plane guard (or *Pédro*) during flight operations. They also equipped many smaller French warships, but were later mainly relegated to auxiliary ships such as tankers, repair ships and survey vessels. One land-based mission was to escort nuclear missile submarines through the Brest narrows at the beginning and end of their patrols.

For many years all French Navy helicopter pilots were trained on the Alouette III. The mission passed to the Dauphin in 2018, as the SA 316B lacked an autopilot and was the only single-engined helicopter in service. It could not fly at night, requiring the Dauphin to take over *Pédro* duties after sunset. The final three Aéronavale Alouette IIIs were retired at the end of 2022, to be replaced by the Airbus H160M.

Although published production figures vary, about 1,525 Alouette IIIs were built in France and a further 551 under licence in India, as well as about 272 by IAR in Romania and 60 by F+W in Switzerland. More than 70 nations used Alouette IIs and/or IIIs, although only a handful took them to sea.

Argentina operated 14 SA 316Bs from 1969-2010, one of which went down with the cruiser *General Belgrano* in 1982. Another four were lost in accidents. Belgium's Naval Component received three SA 316Bs in 1971, retiring them after 50 years service.

South Korea's Navy introduced the Alouette III in 1977-99 and seems to have operated ten examples of the SA 319B with radar and AS.12 missile capability. During a period of greater tension with the North in August 1983, one operating from the destroyer *Kangwon* north of Pusan attacked and sank a North Korean spy ship with a missile. The RoKN Alouettes were phased out from 2006 but not finally retired until December 2019.

Hindustan Aeronautics Ltd. (HAL) built the type under licence as the Chetak and these equipped various branches of the armed forces. The Indian Navy operates them from its smaller ships and sometimes from its carriers as well as for training with as many as 42 still in service.

Along with the Sea King, the Alouette III is one of the few aircraft used by both India and Pakistan. The Pakistan Navy's aircraft came from a variety of sources, including the UAE, the Netherlands and from France, with the six arriving in 1977 and some surplus aircraft supplied as recently as 2014. They serve as trainers for Sea King crews and for the usual SAR and utility duties aboard Pakistan's warships. Around seven are still operational with 333 Squadron today. ■

Aérospatiale SA 319 Alouette III

Crew: Two
Fuselage length: 32ft 11in (10.03m)
Rotor diameter: 36ft 2in (11.02m)
Height: 9ft 10in (3m)
Empty weight: 2,513lb (1,143kg)
All-up weight: 4,980lb (2,250kg)
Powerplant: One Turboméca Astazou XIV turboshaft, rated at 870shp (649kW)
Max speed: 136mph (220km/h)
Range: 375 miles (605km)
Service ceiling: 10,170ft (3,100m)
Armament: Two Mk. 44 torpedoes or two AS. 12 missiles

The Wessex HAS.3 of HMS Fife *flies by the County-class destroyer during a visit to Singapore in 1970.*

Westland Wessex

Camels and Junglies

The Wessex was the first turbine-powered helicopter to be manufactured in quantity. In British service it saw action in most of Britain's colonial outposts from the 1960s until the 2000s.

The Royal Navy sought an ASW helicopter that could undertake both the hunter and killer roles and operate in bad weather and at night. The turbine-powered Whirlwind HAS.9 had been a successful conversion of a Sikorsky product, and the S-58 was chosen for the same transformation, with a licence agreement signed in 1956.

Westland re-engined an HSS-1N and it flew with a Napier Gazelle turboshaft on17 May 1957. This actually produced less power than the Wright radial, but was much lighter, giving better performance. The first Westland-built prototype, XL727, flew on 20 June 1958 and intensive flying trials began with the Fleet Air Arm's No. 700H Squadron at RNAS Culdrose in June 1960.

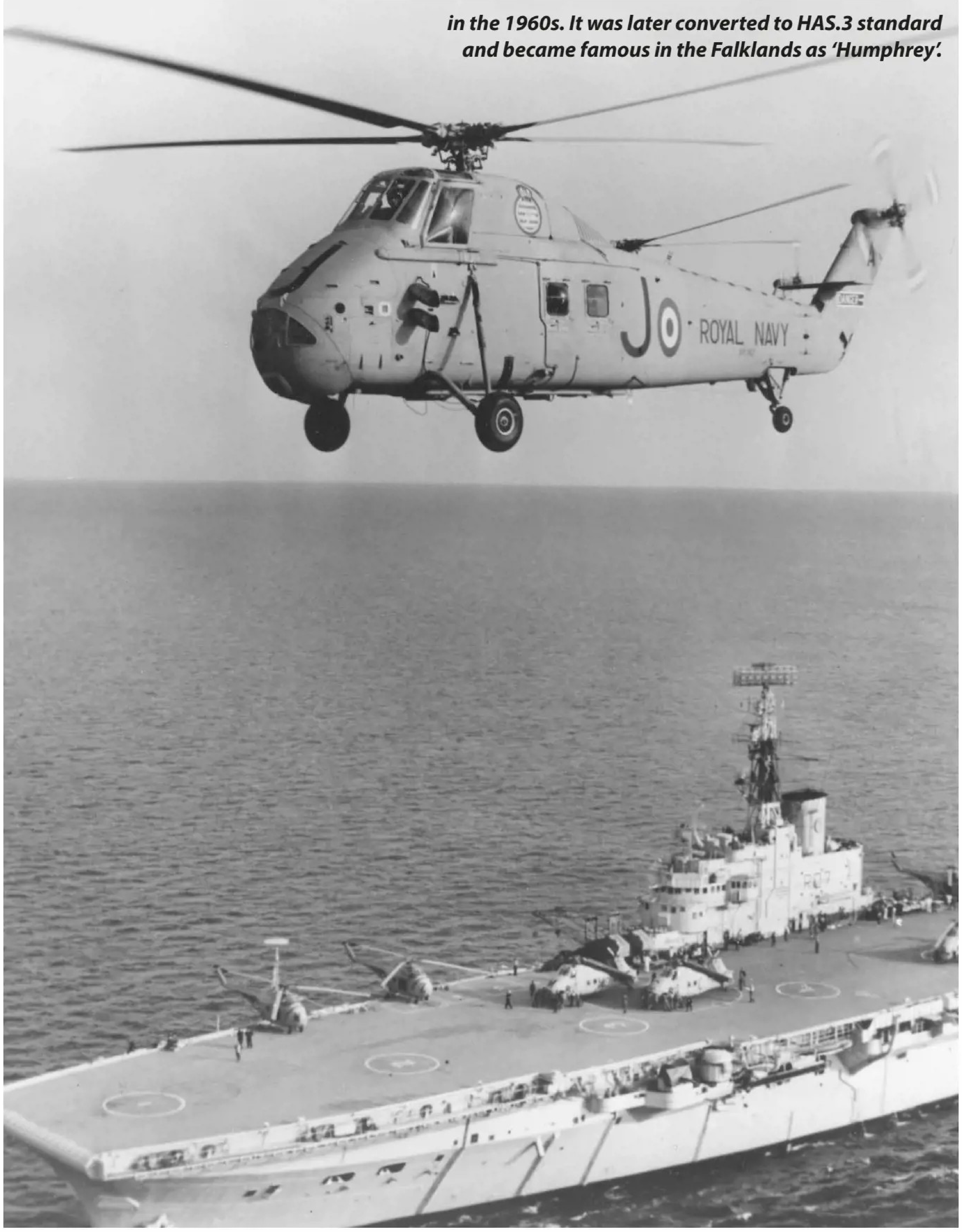
Production HAS.1s had the 1,450shp (1,061kW) Gazelle Mk. 161 engine. Avionics for

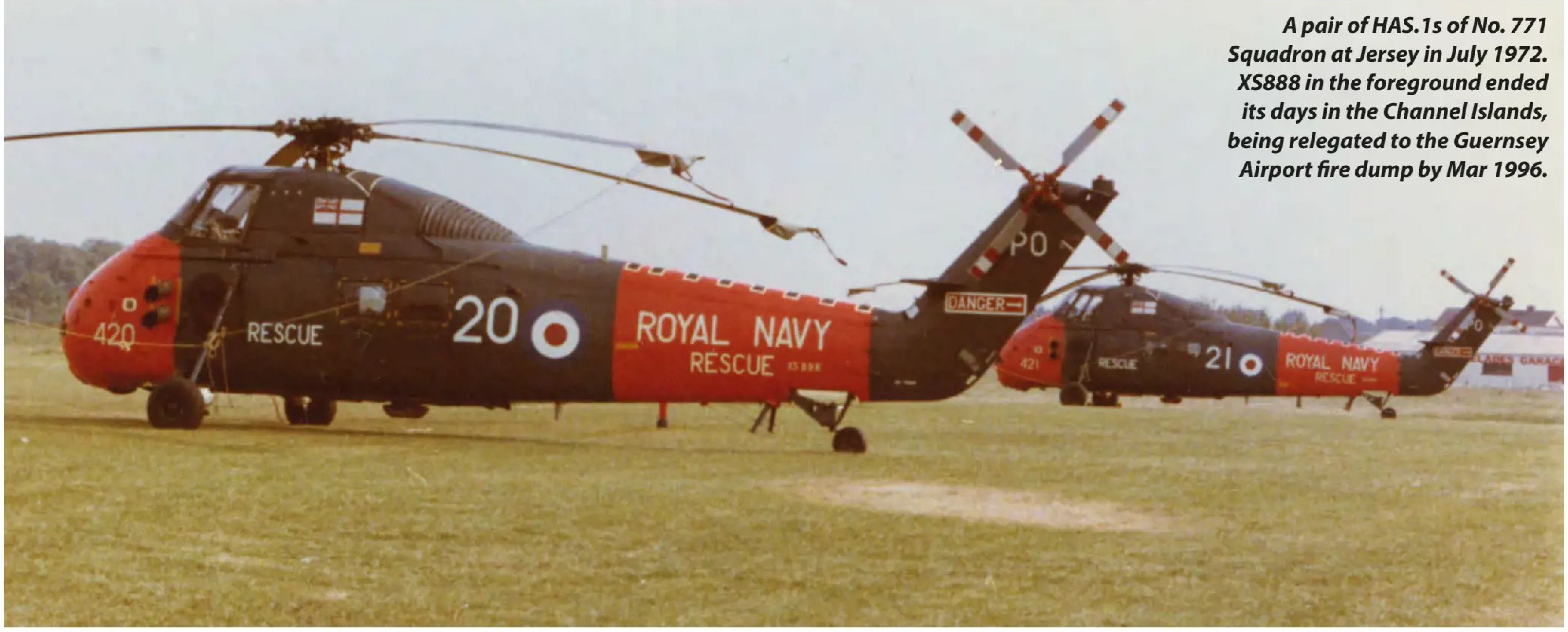
A 'Junglie' Wessex of No. 848 Squadron in Borneo during the 1963-66 timeframe. Westland the ASW mission included a UHF transceiver and homer, a telebriefing system, Ryan AN/APN-97A Doppler radar and a Louis Newmark Mk. 19 autostabilisation system. The HAS.1 could carry Mk. 44 or Mk. 46 torpedoes and depth charges including the WE.177A nuclear depth bomb.

The HC.2 was a transport version designed for the RAF with coupled Bristol Siddeley Gnome engines. The HAS.3 used the Gazelle Mk. 5, rated at 1,600shp (1,193kW). It introduced a new Westland-designed automatic flight control system (AFCS) and a new dorsal radome housed ARI 5955 radar on the 50 HAS.1s converted to HAS.3s, leading to the nickname 'The Camel'. They served aboard HMS *Ark Royal* and with the ship's flights of 'Tiger'-class cruisers and 'County'-class destroyers.

It was recognised that the Wessex had considerable potential in the Commando role, and the HU.5 was developed for troop transport and underslung loads. Prototype HU.5 XS241 flew on 31 May 1963 and the initial production aircraft on 17 November that year. Lack of power was addressed by fitting coupled Gnome H-1200 engines, rated at 1,350hp (1,007kW) It could carry up to 16 passengers or 3,500lb (1,588kg) as a sling load, including light vehicles such as a Land Rover.

HU.5s saw active service in Cyprus, Aden, Borneo and the Falklands War. In Aden the Wessexes carried loads of up to 14 troops to counter rebel activity. They were often operated on missions alongside Westland Scouts, one of would carry the ground commander and a gunner and the others, four additional troops each. During the Confrontation with Indonesia, Jakarta sent raids into British Borneo. The HAS.1 (until 1965) and the HU.5 played an important role in countering these incursions. No. 848


in the 1960s. It was later converted to HAS.3 standard and became famous in the Falklands as 'Humphrey'.


A pair of HAS.1s of No. 771 Squadron at Jersey in July 1972. XS888 in the foreground ended its days in the Channel Islands, being relegated to the Guernsey Airport fire dump by Mar 1996.

NAVY 32
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AIR MAIL

Wessex Mk. 31B lands on HMAS Jarvis Bay in Wellington Harbour, New Zealand in the late 1980s .It is preserved today at Wollongong, NSW. *Jim Winchester*

Squadron carried more than 50,000 passengers and evacuated 500 wounded in 1962-64 alone.

For the Falklands conflict of 1982, the Royal Navy deployed the Wessex across a variety of ships. Three squadrons of HU.5s were reformed and they operated from the aircraft carriers Hermes and Invincible and numerous amphibious and Royal Fleet Auxiliary (RFA) vessels, mostly for troop and supply transport. HAS.3s were embarked aboard the frigates *Antrim* and *Glamorgan*. Nicknamed 'Humphrey', Antrim's XP142 flew several important missions, including the attack on the Argentine submarine *Santa Fe*; the insertion of SAS troops onto the Fortuna Glacier, South Georgia and the rescue of those troops and the aircrew of two HU.5s that crashed during the operation; other SAS insertions and the rescue of RN personnel from the South Atlantic. 'Humphrey' was damaged in an Argentine air attack, but survived to be displayed at the FAA Museum, Yeovilton. *Glamorgan*'s Wessex ('Willie') flew many combat missions but was destroyed when the frigate was struck by a ground-launched Exocet missile.

Another Exocet, launched from a Super Etendard, hit the merchant vessel *Atlantic Conveyer* and six HU.5s were lost when the ship caught fire and subsequently sunk. The Wessex fired missiles of its own in the Falklands, with one HU.5 launching two AS.12s at the Stanley town hall where Argentine commanders were said to be meeting. The attack was unsuccessful, destroying the adjacent police station instead. The HAS.3 was retired shortly after the war, replaced by the Sea King.

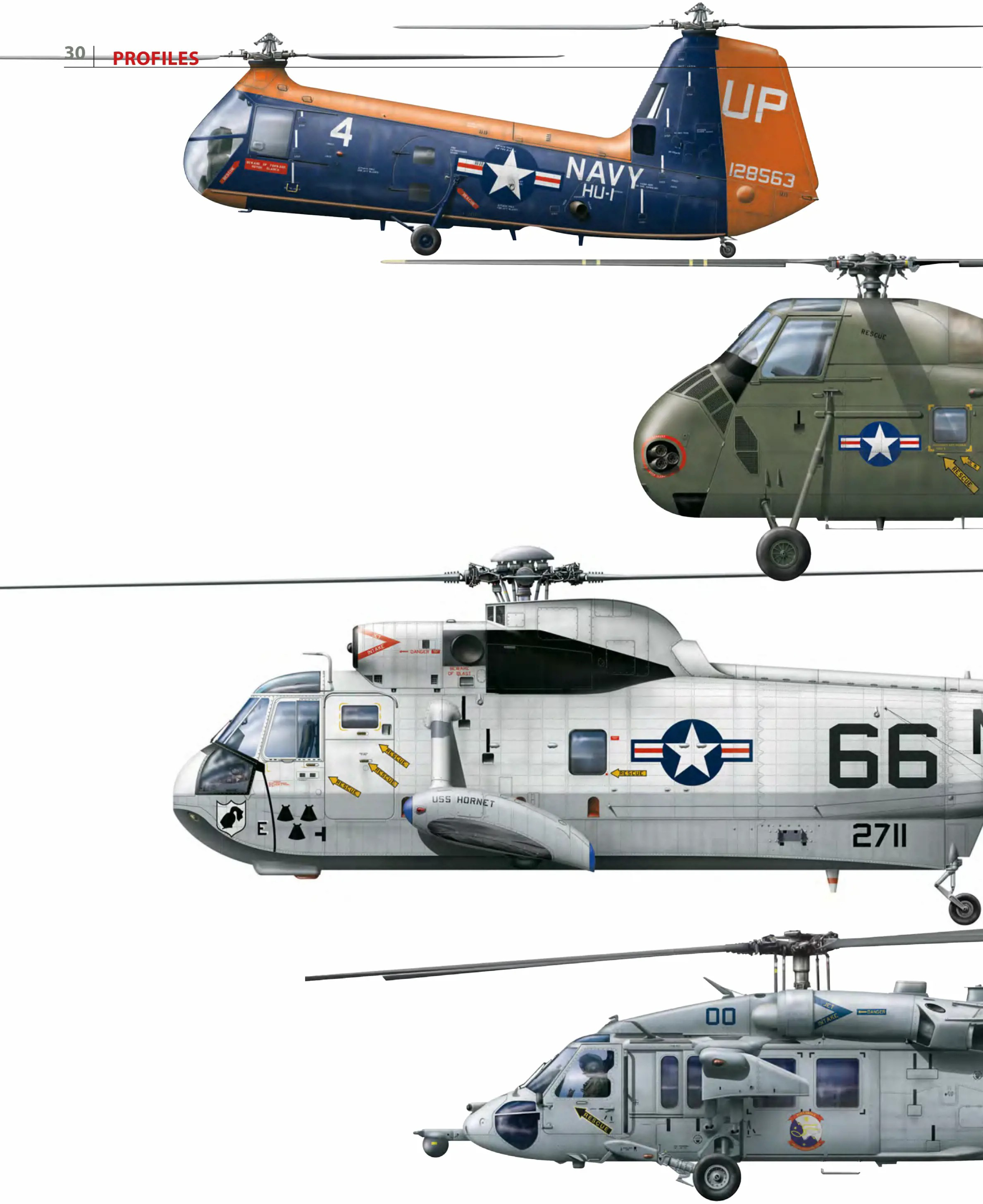
Australia was the only country to buy the type for shipboard use. The Royal Australian Navy ordered 27 HAS.31s in 1961. These were versions of the HAS.1 with a Gazelle Mk. 162 engine rated at 1,575shp (1,175kW) From 1963 they operated aboard HMAS *Melbourne* in the ASW and SAR roles, and in 1967 they sailed on HMAS *Sydney*, which was acting as a troopship to Vietnam. It was recognised that the Mk. 31 was underpowered, and in 1966, 21 were converted with Gazelle Mk. 155 engines to become the Mk. 31B. At the same time a new AN/AQS-13 sonar system was fitted as was station-keeping radar and new communications and navigation systems. When *Melbourne* retired in 1982 the Wessex continued in the utility role until 1989.

A few other air arms operated versions of the type, mostly based on the HC.2. Iraq flew 12 Wessex Mk. 52s from 1963 and some were believed still in service in 1991. Ghana bought two Mk. 53s in 1966 and Brunei had a single Mk. 54, delivered in 1967.

The RAF operated the HC.2 until 2002, notably in Northern Ireland. The last military user was the Uruguayan Navy, which operated three ex-civil Mk. 60s and five ex-RAF HC.2s from 1991 until 2010. Uruguay's Air Force used 11 HC.2s from 1997 to 2007. ■

Westland Wessex HU.5

Crew: Two or three and up to 14 passengers
Fuselage length: 65ft 9in (20.04m)
Rotor diameter: 56ft 0in (17.07n)
Height: 16ft 2in (4.93m)
Empty weight: 8,657lb (3,927kg)
All-up weight: 13,500lb (6,123kg)
Powerplants: Two Rolls-Royce Gnome Mk. 110/111 turboshafts, each rated at 1,350shp (1,007kW)
Max speed: 132mph (212km/h)
Range: 478 miles (769km)
Service ceiling: 14,100ft (4,300m)
Armament: Nord SS.11 missiles, rocket launchers, 7.62mm door gun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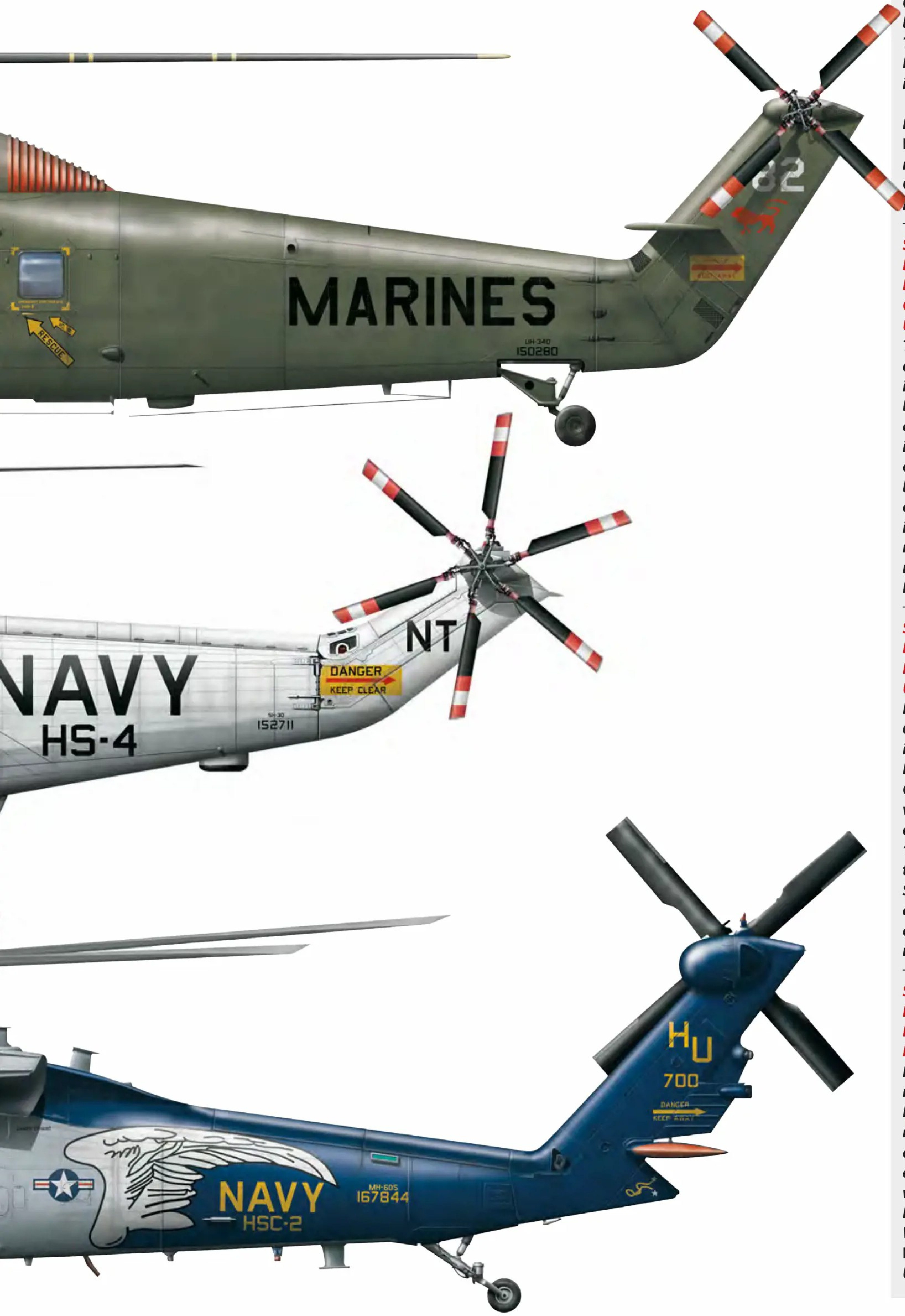


Piasecki HUP-2 Retreiver
Bu. No. 128563, C/n 117
HU-1, United States Navy
Naval Air Station Imperial Beach, California, Circa 1960

HU-1 was established on 1 April 1948 as the Navy's first operational helicopter squadron. On moving to NAS Miramar in 1950 it became known as the 'Pacific Fleet Angels'. The squadron supplied SAR detachments for Pacific Fleet carriers, introducing the HUP-2 in May 1954.

UP-4 was noted with HU-1 Det. E from November 1958-June 1959 aboard USS **Bon Homme Richard** ***(CVA-31). Bu. No. 128563 was redesignated as a UH-25B in October 1962. On 26 March 1964 it was struck off at NAF Litchfield Park, Arizona***

Sikorsky UH-34D Sea Horse
Bu. No. 150280
HMM-363, MAG-15, United States Marine Corps
USS **Iwo Jima** ***(LPH-2) 1967-68***

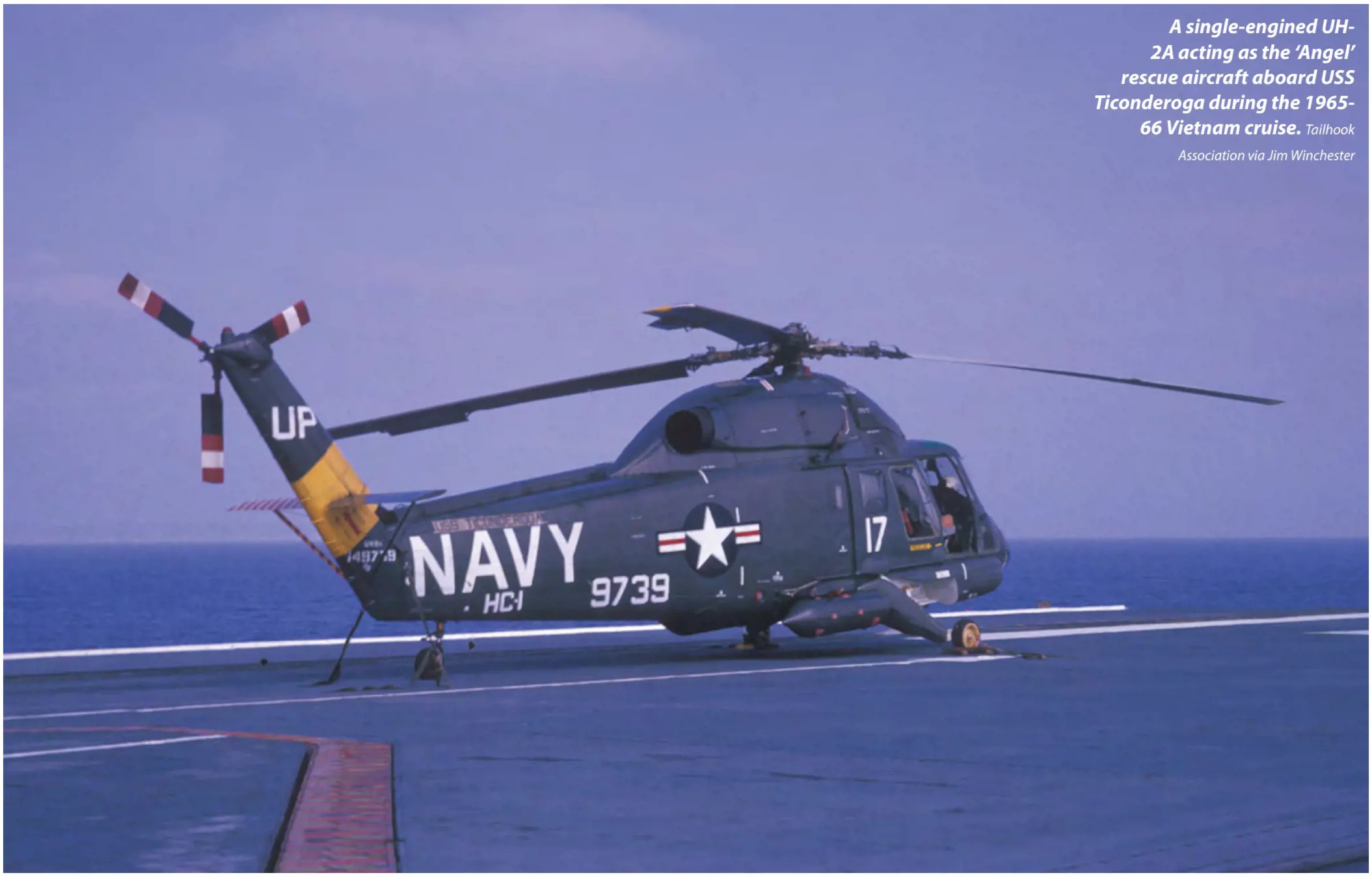
The 'Lucky Red Lions' of HMM-363 were based aboard **Iwo Jima** ***and at various locations in South Vietnam. UH-34D YZ-82 was flown by different pilots but usually with crew chief Cpl T. A. Barta and gunner J.P. Malone in the cabin. It was damaged on numerous occasions, taking small arms hits to the rotor blades, windscreen and nose, tail pylon and elsewhere, with a navy corpsman wounded in August 1967. It was also damaged by mortar fragments while in a landing zone and narrowly avoided two surface-to-air missiles. It had left the squadron by January 1969.***

Sikorsky SH-3D Sea King
Bu. No. 152711, C/n 61-377
HS-4, CVSG-59, United States Navy
USS **Hornet** ***(CVS-11), 1969***

Delivered on 4 March 1967, 152711 or 'Helo 66' became probably the most famous individual helicopter in history. Assigned to HS-4 'Black Knights' at NAS Imperial Beach, California, it became the primary recovery vehicle for Apollo 8, 10 and 11. In line with a change in regulations it was then recoded '740' but temporarily repainted as '66' for the Apollo 12 and 13 missions. It also flew the Shah of Iran in 1973. The Sea King crashed during a nighttime ASW training mission off San Diego on 4 June 1975 and was never recovered.

Sikorsky MH-60S Nighthawk
Bu. No. 167844, C/n 70-3208
HSC-2, United States Navy
NAS Norfolk, Virginia, 2011

Nighthawk Bu. No. 167844 was noted in these markings in May 2010. Befitting squadron HSC-2's nickname 'Fleet Angels' and its role in supplying rescue aircraft for carrier operations, the artwork on the 'CAG-bird' or commander's aircraft, HU-700, depicts angel's wings. Other sightings of 167844 were with HSC-28 'Dragon Whales' aboard USS *George Washington* ***2006, HSC-11 'Dragonslayers' on*** **Harry S Truman** ***in 2018 and HSC-28 again on USS*** **Kearsarge** ***in 2022.***



A single-engined UH-2A acting as the 'Angel' rescue aircraft aboard USS Ticonderoga during the 1965-66 Vietnam cruise. *Tailhook Association via Jim Winchester*

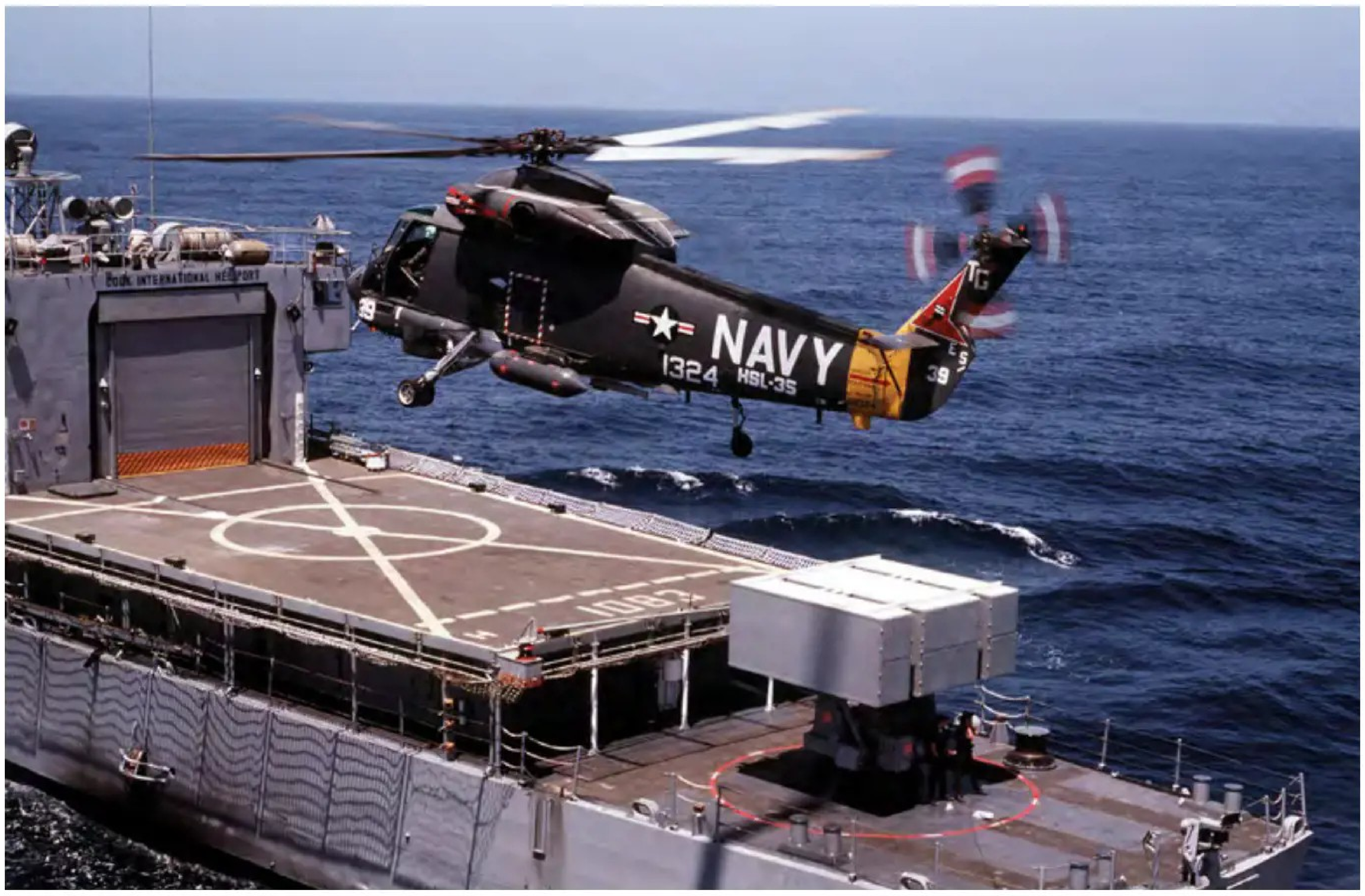
Kaman H-2 Sea Sprite

Small Ship Star

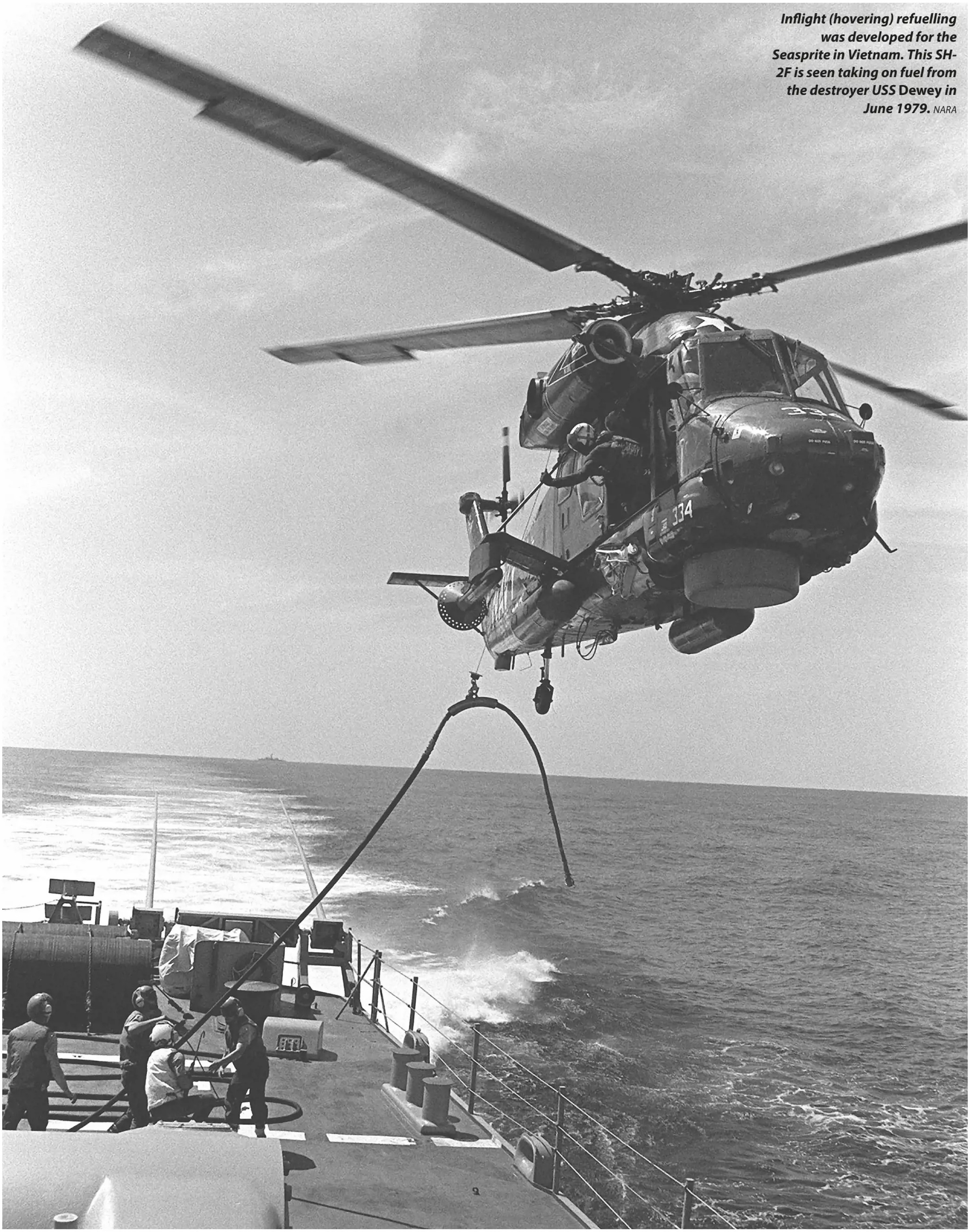
For a helicopter first flown in the 1950s, the Seasprite has had a remarkably long career and was reborn several times. Over the years it evolved from a single-engined utility machine to a capable twin-engined anti-submarine and anti-ship platform

The Kaman company is noted for its quirky rotorcraft, many of them with intermeshing rotors, including the H-43 Husky, which was operated in small numbers by the USMC as the HUK. A 1956 US Navy request for proposals sought a helicopter that could operate from smaller ships and Kaman offered its K-20 design with a single four-bladed main rotor. This was all-metal and featured manual folding for shipboard stowage. The most innovative feature was a servo-tab control system that adjusted the rotor pitch by moving small flaps near the tips.

There were sliding doors on each side on the fuselage. The door on the right side was larger to also allow access to the main cabin.



The landing pads of many ships left little margin of error. An SH-2F of HSL-35 lands over the aft Mk-25 eight–cell Sea Sparrow missile launcher of the 'Knox'-class frigate USS Cook in 1981. This Seasprite was written off aboard USS Barbey in June 1983. *NARA*



Inflight (hovering) refuelling was developed for the Seasprite in Vietnam. This SH-2F is seen taking on fuel from the destroyer USS* Dewey *in June 1979. *NARA*

Most USN Seasprites went grey in their later years. SH-2F 149026 of HSL-30 ditched in the Atlantic six months after this January 1986 photo, but was recovered and put on display at NAS Norfolk. *NARA*

NAVY
HSL-30
9026
030

The unusual main undercarriage pivoted forward to retract into the fuselage, improving aerodynamic efficiency. The prototype and early versions had single-wheel units, with double wheels added later in production.

A contract was awarded in November 1957 for 88 HU2K-1s. The YHU2K-1 flew on 2 July 1959, followed by three further prototypes. Named Seasprite when production started, by the time it entered service with HU-2 at 'Fleet Angels' at NAS Lakehurst, New Jersey on 19 December 1962, the designation had changed to SH-2A.

Due to a dispute with the Pentagon over the supply of some government-furnished equipment, 102 Sea Sprites were delivered without it and were designated SH-2Bs. They were almost identical to SH-2As and when the disagreement was over and the gear was provided, they were actually identical.

The early SH-2s operated in three-aircraft detachments from aircraft carriers for SAR and utility They were equipped with searchlights and loudhailers. A 'fishing pole' device could be swung out beside the cabin from which a rescue hoist was lowered. This allowed the pilot to keep the survivor in view without having to turn his head and possibly lose orientation. In September 1966 two UH-2As from USS *Oriskany* rescued 44 crewmen from the grounded ore carrier SS *August Moon* as well as the crew of the aircraft carrier's third Seasprite, which was knocked down by a huge wave.

SH-2A/Bs were powered by a single General Electric T58-GE-8B turboshaft with a max power rating of 1,250shp (930kW). The early Sea Sprites suffered from engine failures and thus crashes. It was decided to provide a safety margin by adding a second engine. This also increased climb rate and service ceiling, but speeds were similar and range decreased. Entering fleet service from September 1967, converted aircraft became H-2Cs, most of which were fielded as UH-2C utility aircraft, although there were six HH-2Cs for combat search-and-rescue (CSAR). These had additional armour and a six-barrelled 7.62mm Minigun in an undernose turret and M60 machine-guns on flexible side mounts. There was one NUH-2C trials aircraft, which was tested with Sidewinder and Sparrow air-to-air missiles. The 67 HH-2Ds were A/Bs converted for SAR without weapons or armour, and there were 20 SH-2D ASW versions. SH-2Ds were intended to fulfil the Light Airborne Multi-Purpose (LAMPS) mission and introduced a LN66 search radar, which gave over-the-horizon targeting capability.

Seasprites were sometimes detached from carriers to smaller ships from where they could undertake inshore and overland combat search and rescue (CSAR) missions. This proved the concept of operating helicopters off 'small boys' as frigates, destroyers and even cruisers were known to carrier crews. Many of these ships had helicopter platforms left over from the

The Polish Navy has operated the SH-2G since 2002. Seen here conducting winching operations over the Baltic in June 2025, 163544 was one of the last new SH-2G Seasprites delivered to the US Navy.

Seen with an RN Lynx HMA.8 during Exercise Bersama Lima in October 2008, SH-2G(NZ) NZ3602 served with the Royal New Zealand Navy from 2002 to 2016 and now flies in Peru. *Able Seaman Nadia Monteith, RAN*

abandoned DASH ASW drone programme, but no hangars that could house a helicopter.

In June 1968, Lt Clyde Lassen of HC-7 piloted a UH-2A to a daring nighttime rescue of an F-4 Phantom crew shot down over North Vietnam. Despite damage from enemy fire and striking trees, the helicopter made it back to a destroyer with only five minutes fuel remaining. Lassen was awarded the Medal of Honor, the first naval aviator to receive it in the Vietnam War.

The Army saw potential for the SH-2's use as a transport and as a gunship. In 1963 it was evaluated in the utility role, but lost out to the Bell UH-1D Iroquois, despite higher overall performance. Later the same year it competed with the Bell 209 (AH-1 Cobra), and a version of the Sikorsky S-61/H-3 Sea King. Named the 'Tomahawk', the gunship H-2 had stub wings for mounting rocket launchers and a nose turret containing four swivelling 7.62mm machine-guns. In a fly-off against the Cobra, the Tomahawk proved more stable with better weapons accuracy, but Bell had more political support and the Cobra was selected.

A jet-assisted compound version was tested with a YJ85 engine on the starboard side and long wings from a Beech Queen Air. It reached 216mph (348km/h) and could potentially have achieved 275mph (443km/h) with a second engine, but Army funding ran out before it could be developed further.

The SH-2F had its tailwheel located further forward to fit on smaller flight decks. Normally fitted on the starboard side was the AN/ASQ-81(V)2 towed MAD 'bird'. Earlier models were brought up to SH-2F standard and production was restarted in 1972 to build new examples. The Seasprite was unsuccessful in the LAMPS III contest, but was retained to equip a variety of frigates and cruisers. Production began yet again in 1981 of 60 SH-2Fs, the last six of which were completed as SH-2Gs. The G introduced the General Electric T700-GE-70 engine of 1,723hp (1,285kW), new composite rotor blades and improved ASW and defensive systems. Later they were equipped with the Kaman Magic Lantern laser mine detection system. Entering service in 1993, the SH-2Gs were retired from the USN Reserve in 2003.

Kaman began marketing the SH-2G Super Seasprite on the international market in the 1990 and Egypt became the first export customer of the Seasprite in 1995. The ten aircraft were uncompleted SH-2Fs, brought up to SH-2G(E) standard with AQS-18A dipping sonar and a digital hover coupler. Delivered in 1997-98, they fly off five former USN 'Knox'- and 'Oliver Hazard Perry'-class frigates. At least two have been modernised with a digital automatic flight control system, a FLIR and the ALE-47 countermeasures system.

Australia bought 11 SH-2G(A)s with substantial modifications including Penguin missile capability in 1997, while New Zealand ordered five more standard SH-2G(NZ)s which could fire the AGM-65 Maverick missile, The Australian programme proved too complex and was cancelled, with the aircraft being sold back to Kaman, who then sold them to New Zealand as SH-2G(I)s. No. 6 Squadron, RNZAF operates the Seasprite for the RNZN from its 'Anzac'-class frigates and other vessels. In August 2025, Wellington announced the selection of the Sikorsky MH-60R to replace its five operational Seasprites.

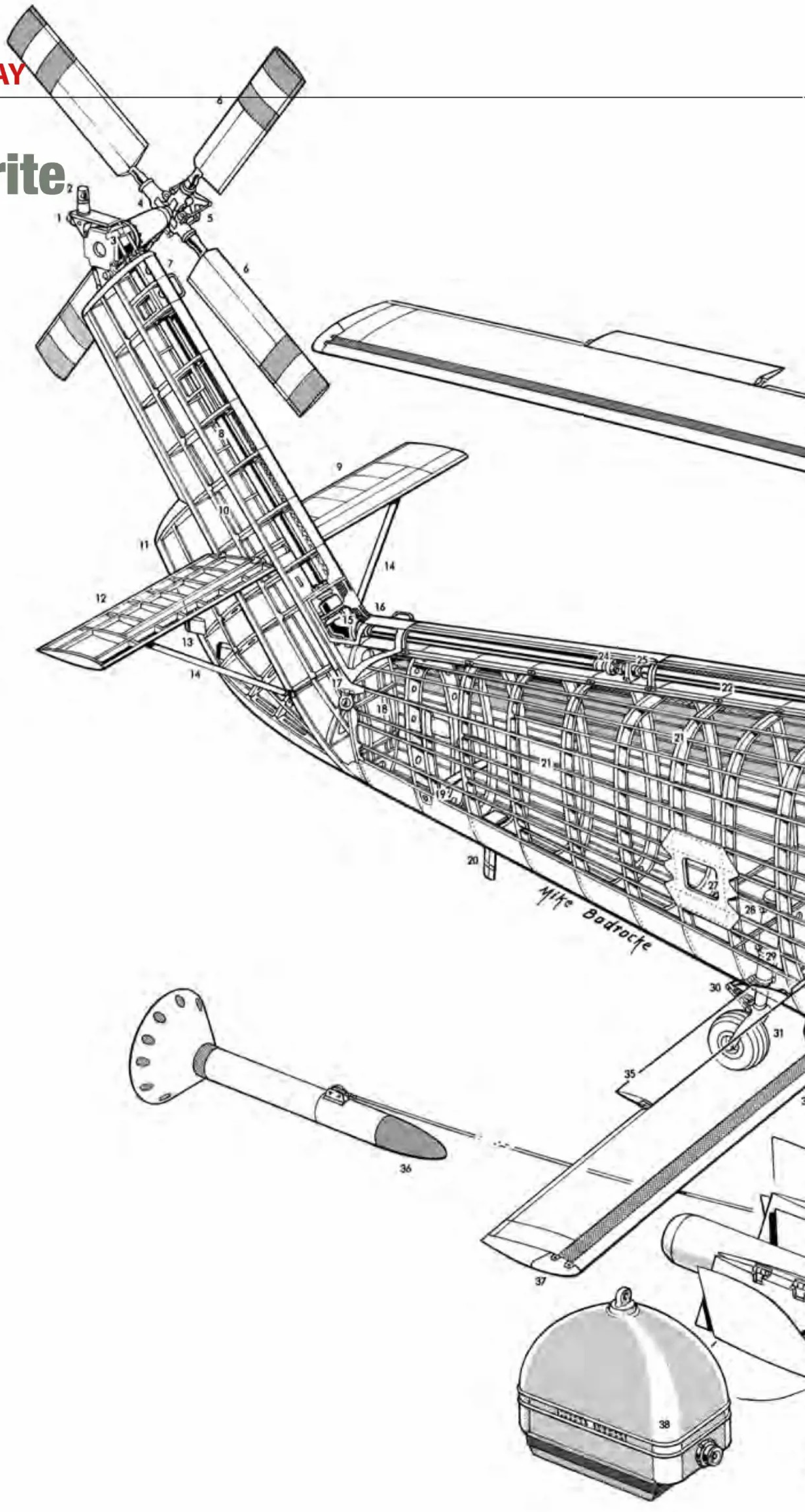
The US donated two 'Oliver Hazard Perry'-class frigates to Poland in 2002-2003. The Seasprite was one of few capable helicopters that could be operated from these ships and four were ordered, becoming operational with the 38th Naval Air Squadron in October 2003. Initially unarmed, they were later fitted with Soviet-designed 7.62mm PK/PKM machine-guns and capability to employ the MU90 torpedo.

For Peru Kaman rebuilt four ex-New Zealand SH-2Gs and one provided by the company to SH-2G(P) standard, with a new sonobuoy and stores management system. In 2021 they entered service aboard the Peruvian Navy's four 'Lupo'-class frigates. ■

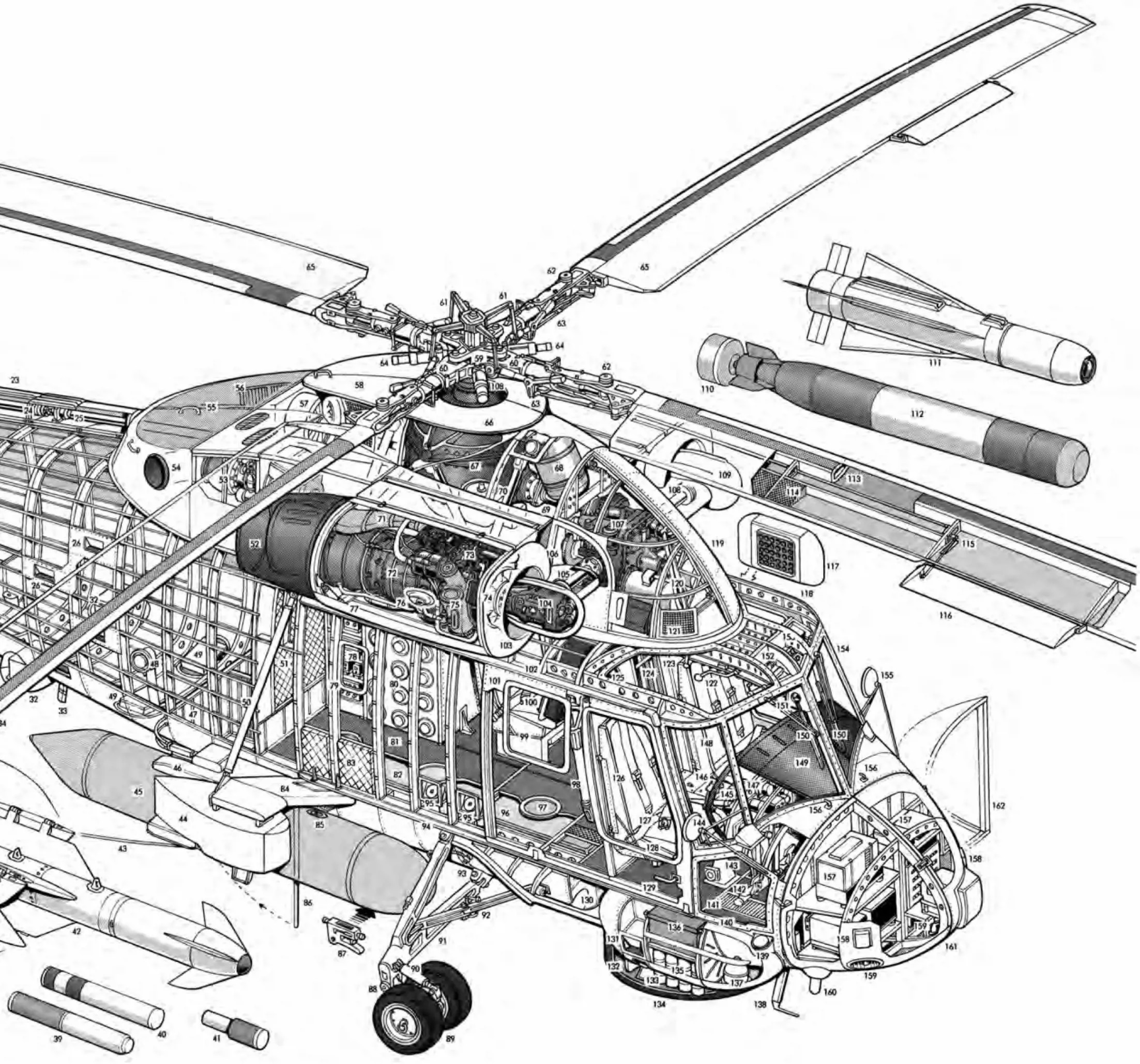
Kaman SH-2F Seasprite

Crew: Four
Length Overall: 52ft 7in (16.03m)
Rotor diameter: 44ft 0in (14.41m)
Height: 15ft 6in (4.72m)
Empty weight: 7,040lb (3,193kg)
All-up weight: 13,500lb (6,124kg)
Powerplant: Two General Electric T58-8F turboshafts, each rated at 1,350shp (1,007kW)
Max speed: 165mph (265km/h)
Range: 411 miles (661km)
Service ceiling: 15,400ft (4,694m)
Armament: Up to 1,200lb (544kg) of external ordnance including two Mk. 46 lightweight torpedoes, depth charges and door-mounted M60 7.62mm machine-guns

Kaman SH-2G Super Seasprite



1 Tail navigation light
2 Anti-collision beacon
3 Final drive right-angle gearbox
4 Tail rotor hub mechanism
5 Blade pitch control linkage
6 Four-bladed tail rotor
7 Handgrip
8 Tail rotor final drive shaft
9 Fixed horizontal tailplane
10 Tail rotor pylon structure
11 Trailing-edge segment, cambered to port
12 Tailplane rib structure
13 Aft radar warning antenna
14 Tailplane bracing struts
15 Bevel drive gearbox
16 Gearbox cooling air grille
17 Tie-down shackle
18 Tail pylon attachment bulkhead
19 Fuselage lifting bar
20 UHF antenna
21 Rear fuselage frame and stringer structure
22 Tail rotor transmission shaft
23 Transmission shaft spine fairing
24 Shaft flexible couplings
25 Shaft bearings
26 Maintenance access steps
27 Rear fuselage access panel
28 Tailwheel strut mounting
29 Shock absorber leg strut
30 Torque scissor links
31 Non-retracting castoring nose wheel
32 AN/ALR-66 ESM antenna fairings, port and starboard
33 UHF antenna
34 Main rotor blade leading-edge anti-erosion sheath
35 Blade servo-flap
36 AN/ASQ-81(V)2 towed magnetic anomaly detector (MAD)
37 Blade tip tracking/balance weight
38 'Magic Lantern' laser scanner
39 DIPAR sonobuoy
40 DICASS sonobuoy
41 Smoke marker
42 Kongsberg Penguin Mk. 2, Mod 7 folding fin anti-ship missile
43 MAD towing cable
44 MAD housing and winch unit
45 378 litre (100 US gal) external fuel tank
46 External stores pylon mounting
47 Fuselage waterproof hull structure
48 Pressure refuelling/defuelling connector
49 Navigational antennas, port and starboard
50 MAD pylon bracing strut
51 Cabin rear bulkhead
52 Engine exhaust shroud
53 Turbomech T-62 auxiliary power unit (APU)
54 APU exhaust
55 Hinged access panels
56 Port side oil cooler exhaust ducts
57 Transmission oil cooler, shaft-driven from rotor gearbox
58 Rotor head tail fairing
59 Titanium rotor hub
60 Blade flapping and drag hinge fairing
61 Blade pitch control links
62 Main rotor blade manually foldable hinge joints
63 Servo-flap control linkage
64 Blade drag dampers
65 Four-bladed main rotor
66 Rotor head fairing
67 Main rotor gearbox
68 Transmission oil tank
69 Input shaft from from combining gearbox
70 Gearbox mounting struts
71 Engine intake particle separator air duct
72 General Electric T700-GE-401/401C turboshaft engine
73 Engine accessory equipment retractinggearbox
74 Compressor intake
75 Engine oil tank
76 Port navigation light
77 One-piece engine cowling, hinged down to form work platform
78 Mission avionics equipment racks
79 Cabin window panel
80 Sonobuoy launch rack, 15 sonobuoys
81 Space provision for one passenger or or litter patient
82 Rear underfloor main fuel cell, total internal capacity 1,802 litres (476 US gal)
83 Cabin wall insulation blankets
84 MAD unit mounting pylon
85 External tank filler cap
86 Retractable sonobuoy receiving antenna
87 External cargo hook, 4,000lb (1,814kg) capacity
88 Main undercarriage hinged leading axle suspension
89 Twin mainwheels, forward retracting
90 Shock absorber
91 Mainwheel leg yoke
92 Retraction/breaker strut
93 Mainwheel leg yoke pivot mounting
94 Sliding cabin door lower rail
95 Gravity fuel fillers
96 Forward underfloor main fuel cell
98 Rescue hoits/winch, stowed position, 600lb (272kg) capacity
99 Systems operator's seat
100 Instrument console
101 Combined pilot's and main cabin sliding door, single cockpit door to port
102 Sliding door top rail
103 Engine air intake
104 Right-angle 'nose' gearbox
105 Engine power take-off shaft
106 Rotor disc brake
107 Combining input and accessory equipment gearbox
108 Power take-off from port engine
109 Port engine nose gearbox fairing
110 Torpedo drogue parachute container
111 AGM-65 Maverick air-to-surface missile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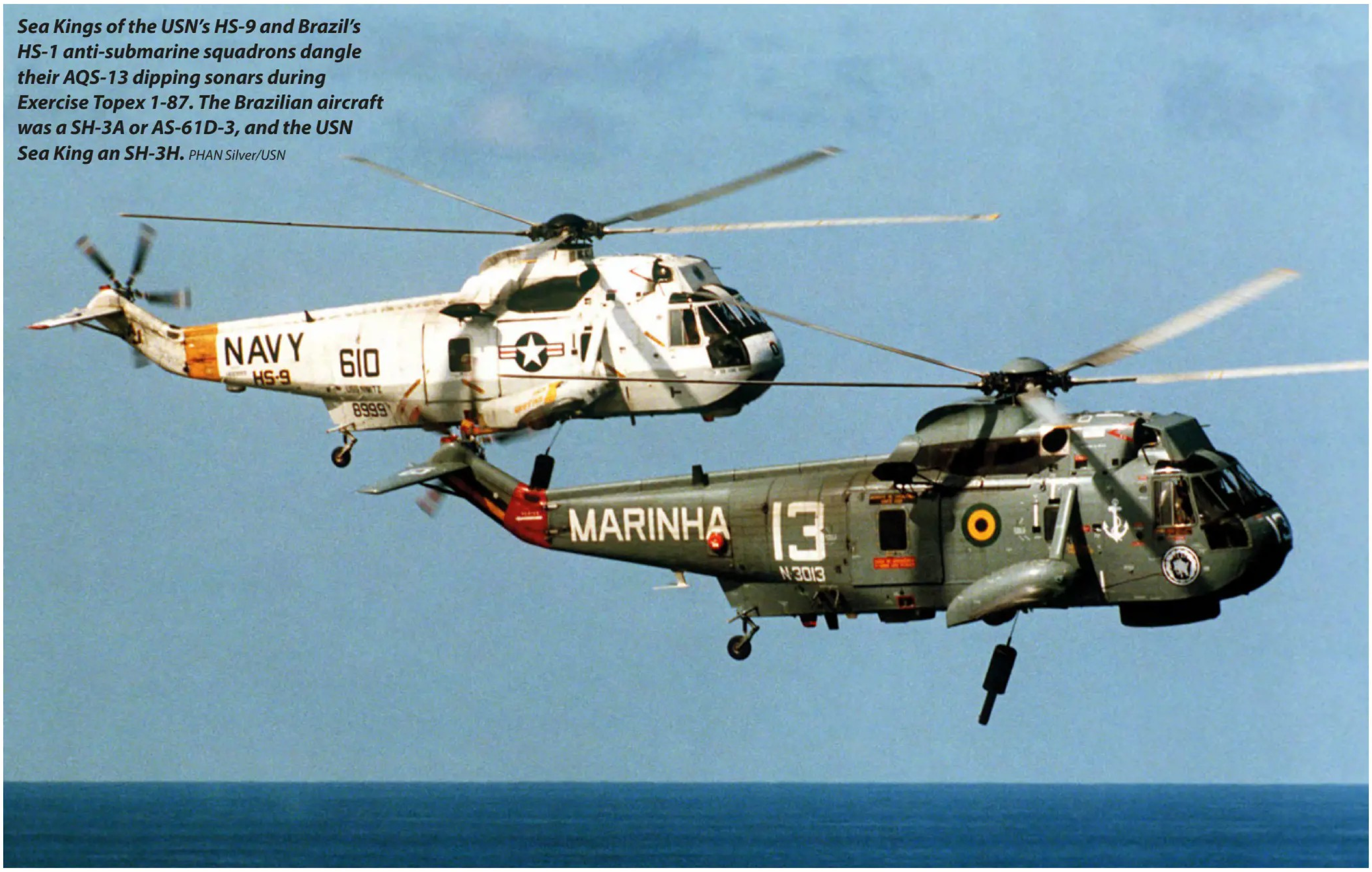
112 Mk. 50 lightweight torpedo
113 Main rotor blade D-section leading-edge spar
114 Honeycomb composite trailing edge
115 Servo-flap control linkage
116 Servo-flap
117 AN/ALQ-144 flare launcher, two on port fuselage
118 Cockpit roof glazing
119 Hinged gearbox front cowling
120 Dual generators
121 Electrical equipment cooling air intake
122 Rotor brake handle
123 Sloping bulkhead
124 Control runs
125 Cabin dome light
126 Pilot's seat
127 Safety harness
128 Bulged cockpit door observation windows
129 Door latch
130 Main undercarriage wheel bay
131 Boarding step
132 Canadian Marconi LN-66HP surveillance radar
133 Ground power socket
135 Marine markers
136 Marker stowage/launch unit
137 Ventral floodlight, lower anti-collision light to port
138 Position of pitot head on port side
139 Windscreen de-icing fluid reservoir filler cap
140 Downward vision window
141 Footboards
142 Yaw control rudder pedals
143 Cyclic pitch control column, full dual controls
144 Pilot's rear view mirror
145 Collective pitch lever
146 Centre column diet
147 Instrument panel
148 Co-pilot/Tactical Control Officer's seat
149 Instrument panel shroud
150 Windscreen wipers
151 Stand-by compass
152 Overhead switch panel
153 Sonobuoy launch control unit
154 Optically flat windscreen panels
155 Co-pilot's rear view mirror
156 Windscreen de-icing fluid spray nozzles
157 Nose compartment avionics equipment racks
158 Forward radar warning antennas
159 Retractable landing light, port and starboard
160 IFF antenna, port and starboard
161 Split hinged nose fairing/access panels
162 Nose fairing folded position, access and hangar stowage



Sea Kings of the USN's HS-9 and Brazil's HS-1 anti-submarine squadrons dangle their AQS-13 dipping sonars during Exercise Topex 1-87. The Brazilian aircraft was a SH-3A or AS-61D-3, and the USN Sea King an SH-3H. *PHAN Silver/USN*

Sikorsky S-61/SH-3 Sea King

Anti-Sub Standard

Designed to a 1957 US Navy requirement for a new anti-submarine warfare (ASW) helicopter to be powered by twin turbine engines, the Sea King performed multiple additional roles over the years, from surface attack to spacecraft recovery. Licence-produced versions were sold around the world.

Bureau Number 1417137, the XHSS-2 prototype, first flew on 11 March 1959, piloted by Robert Decker and Francis 'Yip' Yurrel. Its twin General Electric T58 turboshafts and five-bladed steel honeycomb rotors gave enough power to carry both sonar and weapons, unlike the previous generation, which had to be fielded in hunter-killer teams with one aircraft performing each role.

The broad design came from that of the commercial S-62, which married the dynamic system of the HSS-1 (S-58) with a five-bladed main rotor and a new amphibious hull. Although it would not enter service with the Coast Guard as the HH-52A until 1962, the S-62 preceded the S-61 into the air, flying on 22 May 1958. Carrier suitability trials of the YHSS-2 evaluation aircraft showed high reliability and excellent shipboard handling characteristics, aided by the automatic blade folding system.

The HSS-2 entered service with VHS-3 at Norfolk Virginia and VHS-10 at Ream Field, San Diego in September 1961. The HSS-2 designation was an attempt to secure funding by making it seem the continuation of the earlier HSS-1 series, with which it had nothing in common. It was redesignated SH-3A Sea King under the system introduced in September 1962.

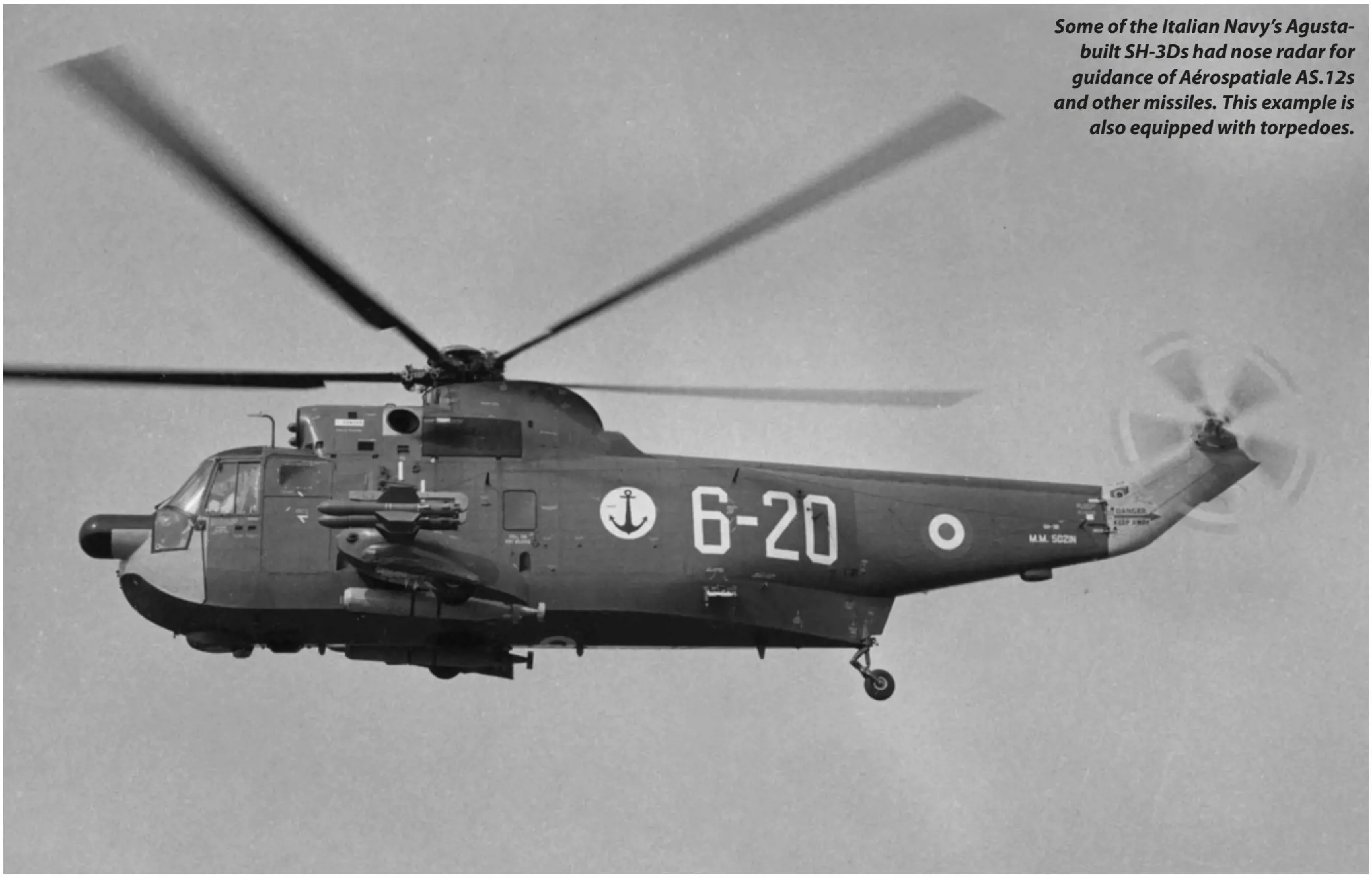
Power for the SH-3A came from a pair of 1,250shp (938kW) General Electric T58-GE-8B turboshafts. Replacement of these with 1,400shp (1,050kW) T58-GE-10s brought about a designation change to SH-3D after production of 100 SH-3As. The SH-3A and other ASW versions used the Bendix AQS-13 or AQS-18 dipping sonar. This could be coupled with the Doppler system and radar altimeter to allow auto-hovering.

For the mine countermeasures (MCM) role, nine SH-3As were converted to RH-3As. They featured a new sliding door on the left side of the cabin, extra observation windows and a rig for towing a minesweeping sled behind the helicopter. This put stress on the tail rotor, which was strengthened, as was the rear fuselage. The RH-3A was mainly an interim machine, mainly used for evaluation before replacement by RH-53As in 1972.

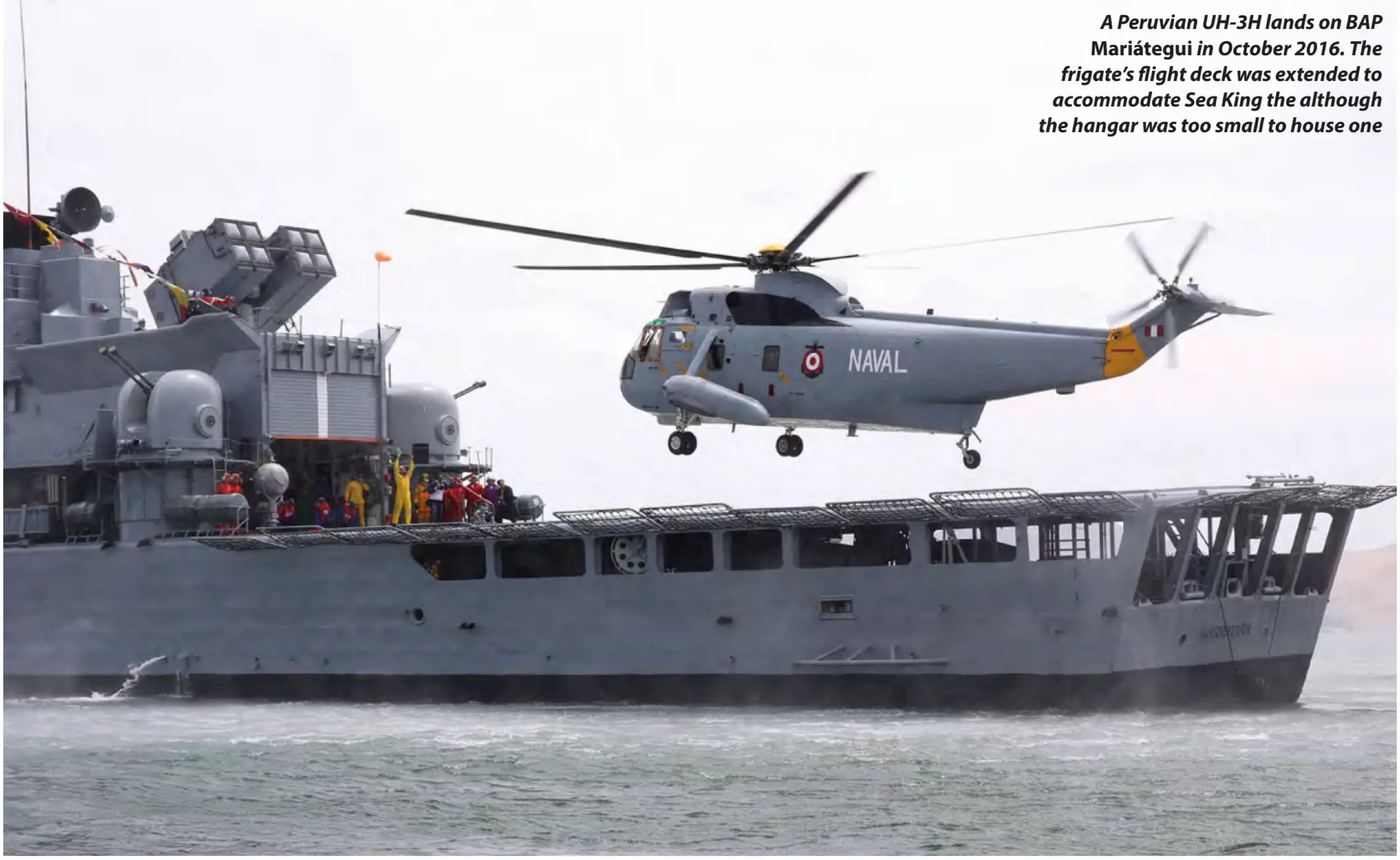
Although also called S-61s and Sea Kings, the HH-3F Pelican for the Coast Guard was based on the USAF CH-3C with a larger ramp-equipped fuselage. The Coast Guard also operated the single-engined HH-52A Sea Guard, as did the JMSDF with nine S-62Js.

USMC use was restricted to HMX-1, which accepted the HSS-2Z (VH-3A) in 1962 and still flies the VH-3D on presidential support duties. When the occupant of the White House is aboard, it uses the callsign 'Marine One'.

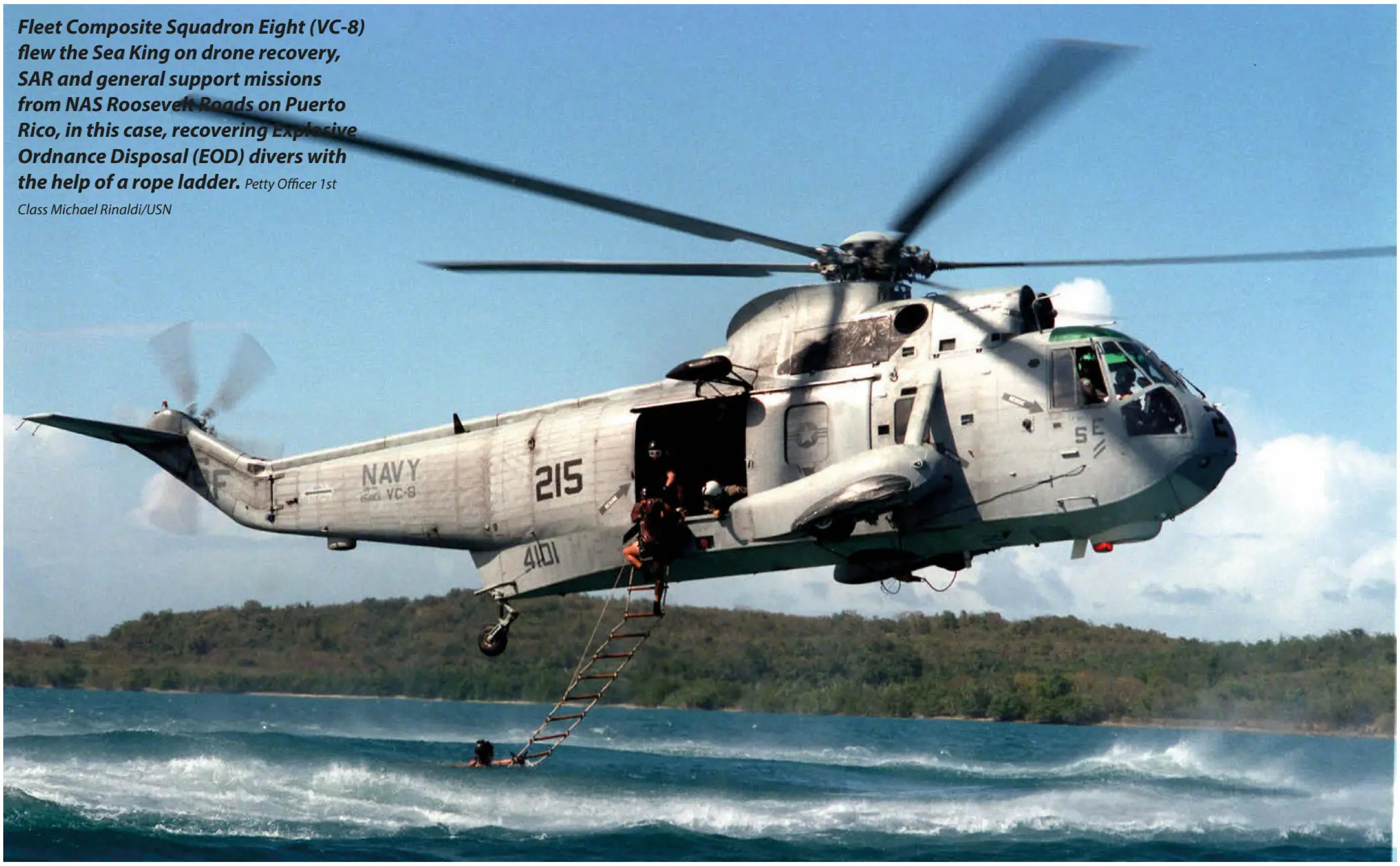
United Aircraft of Canada assembled 41 Sea Kings as the CHSS-2 (later CH-124), accepting



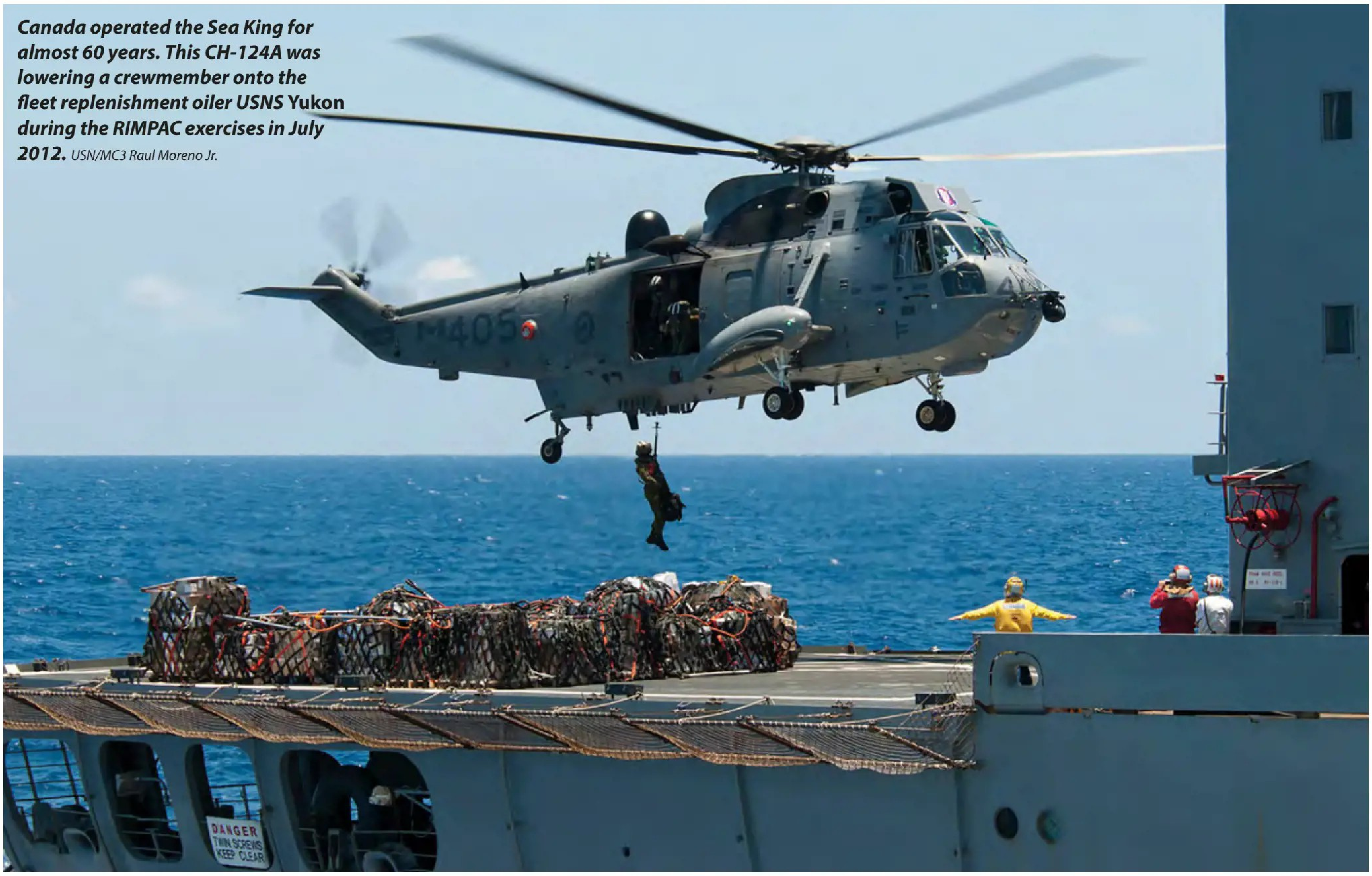
Some of the Italian Navy's Agusta-built SH-3Ds had nose radar for guidance of Aérospatiale AS.12s and other missiles. This example is also equipped with torpedoes.



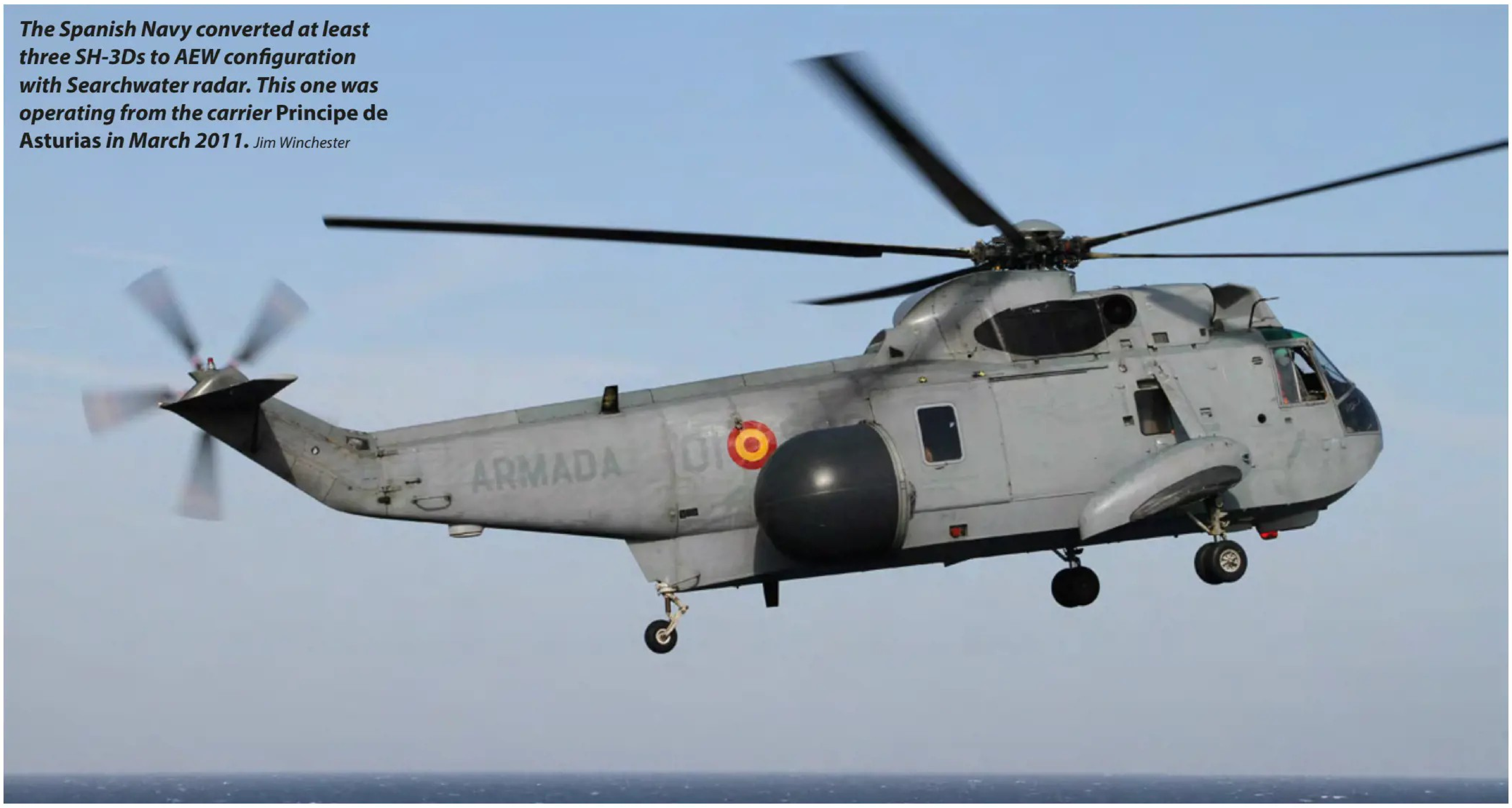
A Peruvian UH-3H lands on BAP* Mariátegui *in October 2016. The frigate's flight deck was extended to accommodate Sea King the although the hangar was too small to house one



Fleet Composite Squadron Eight (VC-8) flew the Sea King on drone recovery, SAR and general support missions from NAS Roosevelt Roads on Puerto Rico, in this case, recovering Explosive Ordnance Disposal (EOD) divers with the help of a rope ladder. *Petty Officer 1st Class Michael Rinaldi/USN*



Canada operated the Sea King for almost 60 years. This CH-124A was lowering a crewmember onto the fleet replenishment oiler USNS **Yukon** ***during the RIMPAC exercises in July 2012.*** *USN/MC3 Raul Moreno Jr.*



The Spanish Navy converted at least three SH-3Ds to AEW configuration with Searchwater radar. This one was operating from the carrier Principe de Asturias *in March 2011.* Jim Winchester

the first in 1961. The RCN developed the 'Bear Trap' system, which locked the CH-124 to the deck and towed it into the hangar. This allowed flight operations in heavy sea conditions with a reduced handling crew. Canadian Sea Kings operated on anti-piracy patrols off Somalia and on many international peacekeeping missions. Canada spent years trying to replace its CH-124s, resulting in several life-extension and modernisation programmes. Over time they received a new acoustic system that used sonobuoys instead of a dipping sonar, a magnetic anomaly detector (MAD) and a new tactical navigation system. In 2018 they were finally retired after 57 years service.

From 1967, Agusta and Mitsubishi built Sea Kings under licence, as did Westland, although its variants are described separately. Between 1968 and 1987, 36 AS-61/ASH-3Ds were built for the Marina Militare in several batches. One batch of 13 was fitted with AN/APN-195 search radar in the nose. Principally used for ASW and anti-shipping missions, the AS-61s also had utility and SAR takings. A few were modified to 'Mazinga' configuration with internal equipment for early warning and signals/electronic intelligence (Sigint/Elint) tasks. Others could launch a pair of Otomat MARTE Mk. 2 ASMs, or were used as Special Forces transports with 7.62mm Miniguns firing from the side windows. Agusta-Sikorsky Sea Kings were also supplied to Argentina, Brazil, Iran, Iraq, Libya, Malaysia, Peru, Saudi Arabia and Venezuela.

No fewer than 187 Sea Kings were operated by the JMSDF, including HSS-2s (S-61Bs), HSS-2As (SH-3Ds) and HSS-2Bs (SH-3Hs). Most of these also had licence-built engines and Japanese avionics. Tokyo's restrictions on arms exports precluded any sales to other customers and the type was retired in 2008.

The USN accepted 396 examples of the Sea King and Sikorsky production lasted just under 20 years, finishing in 1980 with 794 completed. Customers for Sikorsky-built aircraft were relatively few, but included Malaysia (41 S-61A-4 Nuri), Spain (18 SH-3D/G/Hs), Denmark (nine S-61A-1s), Brazil (six new S-61D-3s, plus several ASH-61s and surplus SH-3Ds) and Argentina (five S-61D-4s and four Agusta-built ASH-3Ds. Peru added to its fleet of AS-61Ds and Sikorsky UH-3Hs acquired in 1978 and 2009, respectively, by purchasing six ex-Spanish Navy SH-3Hs in 2022.

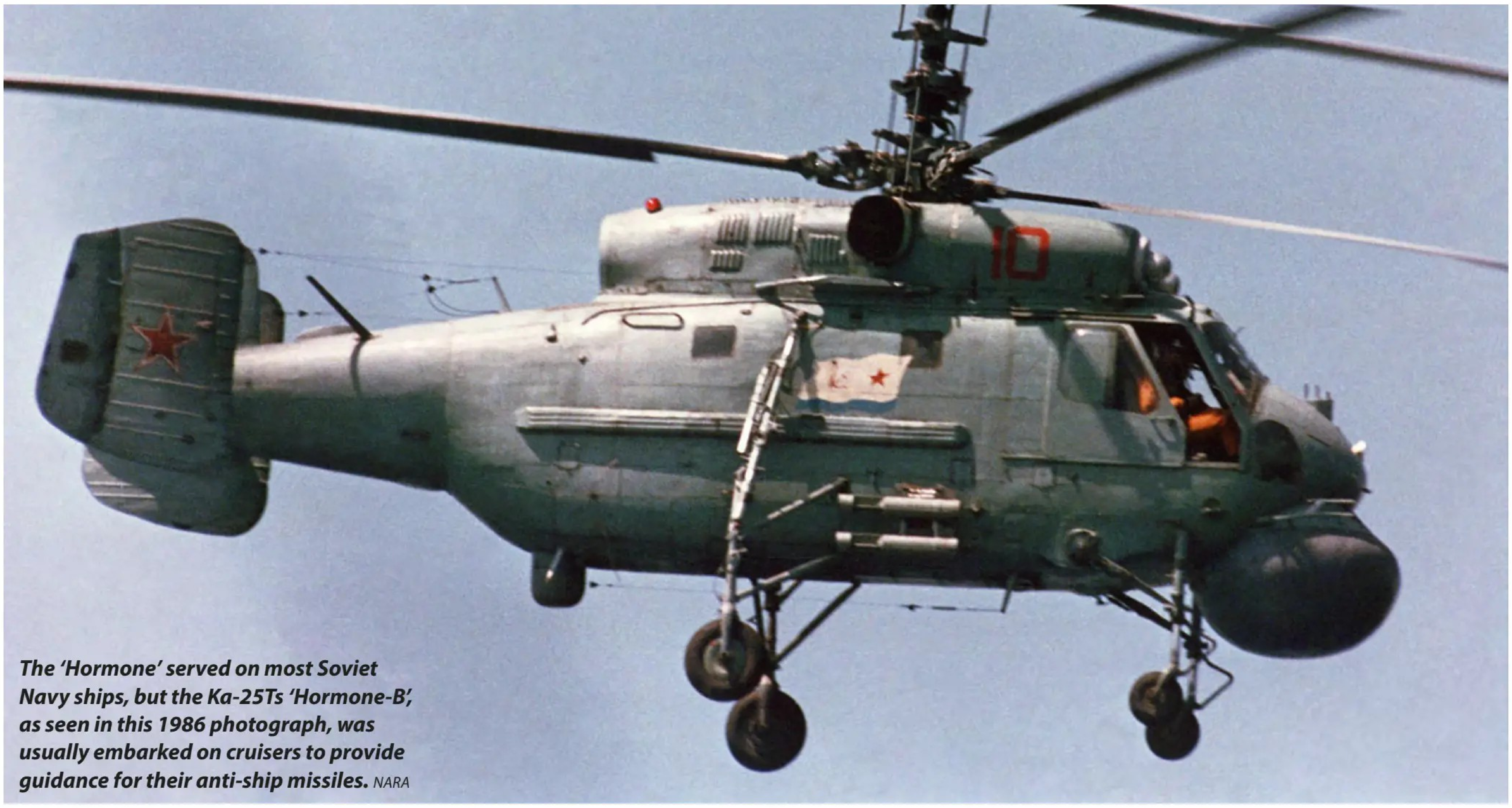
Designed as a version that could swap roles between ASW and utility with the swapping in and out of sonar and other equipment as required, the SH-3G appeared in 1970. The SH-3G took over from the SH-3D on space recovery missions from Apollo 15 onwards. Some were fitted with gun pods by HC-2 for CSAR missions and this squadron operated in the Middle East in the 2000s as the 'Desert Ducks'.

The ultimate US ASW version was the SH-3H with T58-GE-402 engines. As the SH-60F Sea Hawk replaced it in USN service, many examples were stripped of mission equipment and re-issued as UH-3Hs to various composite and utility units. The US Navy announced the 'retirement of the Sea King' several times over the years, forgetting isolated SAR detachments and other users. Today, the VH-3D continues to serve with HMX-1, although is slowly being replaced by the VH-92A.

Carson Helicopters composite rotor blades were retrofitted to many Sea Kings, including the VH-3D, adding 2,000lb (907kg) increase in maximum hover capacity and an increased forward speed. In February 2010 the US State Department announced a requirement for up to 110 modernised S-61s. Fitted with seating for up to 21 passengers, the aircraft would support diplomatic missions in Iraq and Afghanistan. Carson remanufactured some as the S-61T Triton, but surplus civilian-certifiable Sea Kings were in short supply and the US government received very few. ■

Sikorsky SH-3H Sea King

Crew: Three
Fuselage length: 54ft 9in (16.69m)
Rotor diameter: 62ft 0in (18.90m)
Height: 16ft 10in (5.13m)
Empty weight: 12,350lb (5,602kg)
All-up weight: 21,500lb (9,752kg)
Powerplant: Two General Electric T58-GE-10 turboshaft engines, each rated at 1,400shp (1,044kW)
Max speed: 166mph (267km/h)
Range: 625 miles (1,006km)
Service ceiling: 14,700ft (4,480km)
Armament: Four torpedoes or depth charges; B57 nuclear depth bombs; door-mounted M60 machine-guns



The 'Hormone' served on most Soviet Navy ships, but the Ka-25Ts 'Hormone-B', as seen in this 1986 photograph, was usually embarked on cruisers to provide guidance for their anti-ship missiles. NARA

Kamov Ka-25 'Hormone'

Soviet ASW Stalwart

Kamov's co-axial helicopters became the mainstay of Soviet naval aviation from the 1960s to the 1990s, with the Ka-25 being the first to enter widespread service.

The co-axial layout counter-acted torque and eliminated the need for a tail rotor system, which reduced complexity and improved safety, especially for those around the aircraft. It did increase overall height, however, which complicates shipboard stowage and adds many more joints and hinges that all require lubrication. Kamov's first production helicopter, the Ka-10, flew in 1949 and the small naval Ka-15 'Hen' liaison helicopter in 1953. This was very limited in capability and Kamov was directed to develop a turbine-engined successor for ASW use.

A demonstrator flew in 1960 and appeared at the Tushino air show at Moscow in 1961. Nato called it the Ka-20 'Harp'. This was refined into the Ka-25, which received the Nato designation 'Hormone-A' after its first public showing in 1967. Series production of the Ka-25PL was launched at Factory No. 99 at Ulan-Ude in 1966.

The Ka-25PLs were slated to equip the air groups of the Project 1123 'Kiev'-class helicopter carriers. The first operational unit, the 78th Independent Shipborne Anti-Submarine Helicopter Regiment (OKPLVP) at Donuzlav, Crimea supplied helicopters for the *Moskva* and *Leningrad* and the 27th OKPLVP did so for the *Kiev*. The air group of a Soviet ASW carrier, which Moscow designated a heavy anti-submarine cruiser, consisted of 14 Ka-25PLs and a few Ka-25PS 'Hormone-C's for SAR and utility duties. On the Ka-25PS the ASW kit was removed from the cabin and replaced by 12 fold-down seats, but the radar was retained.

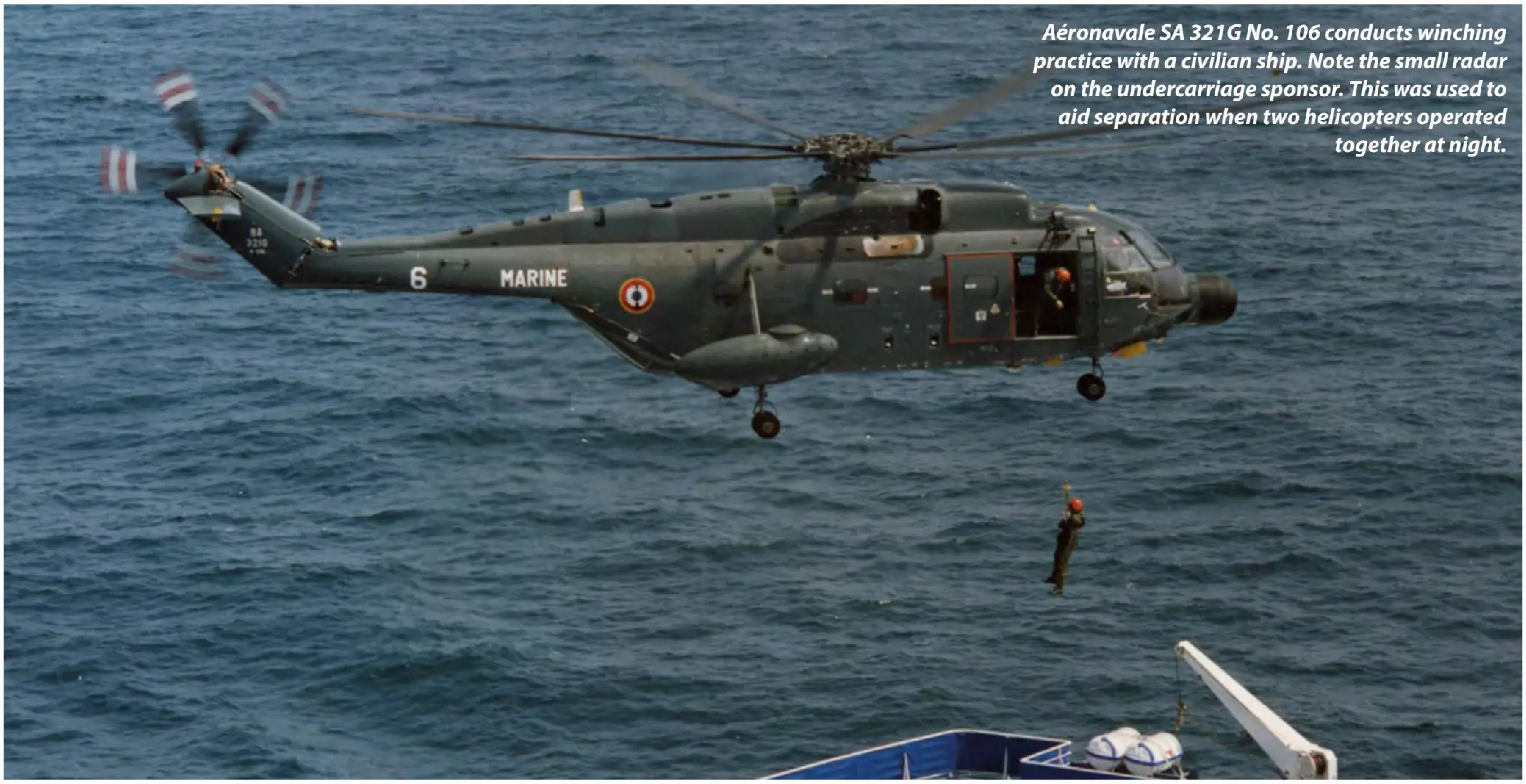
The Ka-25PL was notable for its prominent search radar under the nose (Nato 'Big Bulge') and its large tail fins. There was a magnetic anomaly detector (MAD) pod under the tail and an electronic support/search measures (ESM) system with an antenna on the rear fuselage. The rear fueslage hosed a 'Tie Rod' electro-optical camera. Below the cabin there was space for a linear weapons bay which could house two 450mm torpedoes or conventional or nuclear depth charges.

The Ka-25Ts 'Hormone'-B was the shipborne over-the-horizon weapons targeting version with 'Short Horn' radar in a reshaped radome. Its undercarriage was retractable to keep it clear of the radar scan, which was used to give mid-course guidance to ship- and submarine-launched missiles such as the SS-N-3 'Shaddock' and SS-N-12 'Sandbox'.

Production amounted to 460 Ka-25s delivered between 1966 and 1975. In 1995 the ASW Ka-25PL was retired from frontline Russian Navy service but some may have served longer as trainers. India obtained seven Ka-25s in 1980, INAS 333 operating them mainly from 'Rajput'-class destroyers. They retained the Hormone in service until 2009. Vietnam acquired six of the type, Syria nine and Yugoslavia 12. Bulgaria's Navy operated a single example. ■

Kamov Ka-25PL

Crew: Two; capacity for up to 12 passengers (Ka-25PS)
Fuselage length: 31ft 10in (9.71m)
Rotor diameter: 51ft 8in (15.74m)
Height: 17ft 7in (5.37m)
Empty weight: (4,765kg)
All-up weight: 15,973lb (7,200kg)
Powerplant: Two Glushenkov GTD-3F turboshafts, each rated at 900shp (671kW)
Max speed: 137mph (220km/h)
Range: 249 miles (400km)
Service ceiling: 12,140ft (3,700m)
Armament: Two torpedoes or depth charges



Aéronavale SA 321G No. 106 conducts winching practice with a civilian ship. Note the small radar on the undercarriage sponsor. This was used to aid separation when two helicopters operated together at night.

Aerospatiale Super Frelon

French Heavyweight

Stemming from a 1955 requirement for a heavy transport helicopter, the Frelon evolved into the multi-role Super Frelon, which served a number of operators and remains in widespread use in China.

The first of two Sud-Aviation SE.3200 Frelon (hornet) prototypes flew on 10 June 1959. The four-bladed rotor system and dynamic components were designed by Sikorsky and essentially the same as the Sea King's. The rotor diameter was the same as the Sea King's but the empty weight was twice as great. The addition of a third engine gave an additional 30 per cent power. The gearbox was designed and built by Fiat in Italy. During development, the primary requirement changed to a helicopter that could 'sanitise' France's nuclear submarines from tracking by other subs as they left port.

The Frelon design was thus revised and when the production SA 321G Super Frelon flew on 30 November 1965 it had a sixth rotor blade and a vertical fin. It also had a 'boat' hull, the design of which Sikorsky contributed to. This allowed the Frelon to land on water, although it was not routinely done. A rear ramp was fitted and the large capacity of the cabin not only allowed plenty of ASW gear but also room for passengers or survivors. The tail boom could fold to reduce stowage space.

Some French SA 321s had radomes in the wheel sponsons and others with a thimble nose radome and could carry a pair of AM 39 Exocet anti-ship missiles. In *Aéronavale* service the type supported French nuclear test activities in the Pacific, performed ASW and combat SAR missions and acted as an assault transport among other duties. By the time they were retired in 2010, they were mainly used for land-based SAR.

The Super Frelon was quite an export success for such a large helicopter. Iraq purchased 16 SA 321H versions with ORB-31D radar and Exocet missile capability. They were used extensively in the Iran-Iraq War, with some reports saying three Iranian ships were sunk by Exocets fired by Iraqi Super Frelons. Five were lost up to 1989, two of them reportedly shot down by Iranian fighters, and in 1991 another was destroyed on the ground by a USN Hornet with a Walleye TV-guided bomb.

Six SA 321GMs were delivered to Libya with Omega ORB-32WAS radar in a thimble radome. They were mostly used by the army and the stabilising floats were removed. A dozen SA 321Ks were used as assault transports by Israel from 1966 to 1991

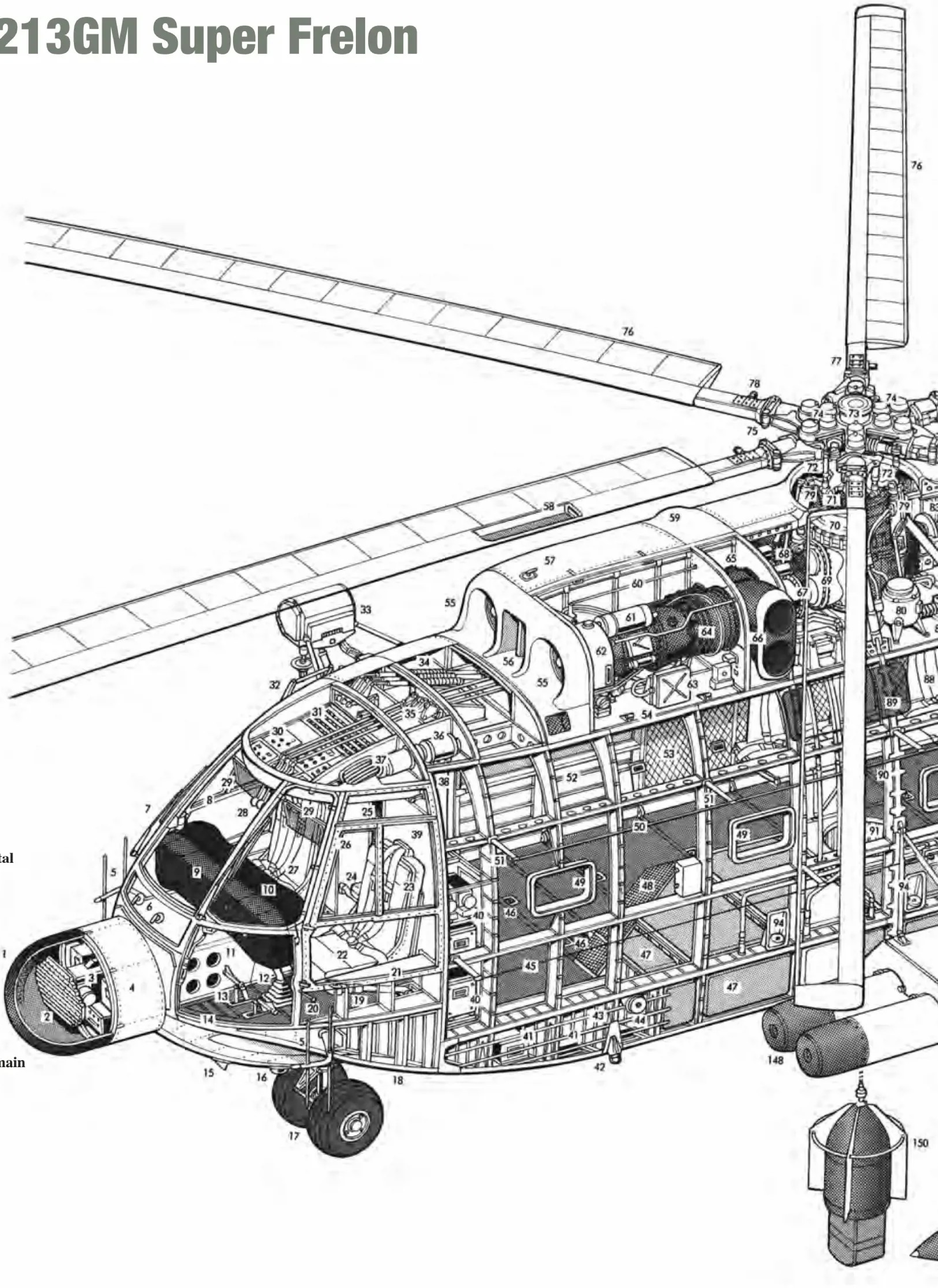
South Africa operated 16 SA 321Ls, using them on operations in Mozambique and Angola during the Bush Wars.

Deliveries ended in 1983 with a total of 99 built in France. In 1975 China took the first of 12 as the Z-8. Production continued in China as the Changhe Z-8, which was produced in several versions for ASW, SAR and troop transport, some as recently as 2013. In 2024, approximately 34 serve with the People's Liberation Army Air Force, 29 with the Navy and 67 with the ground forces. ■

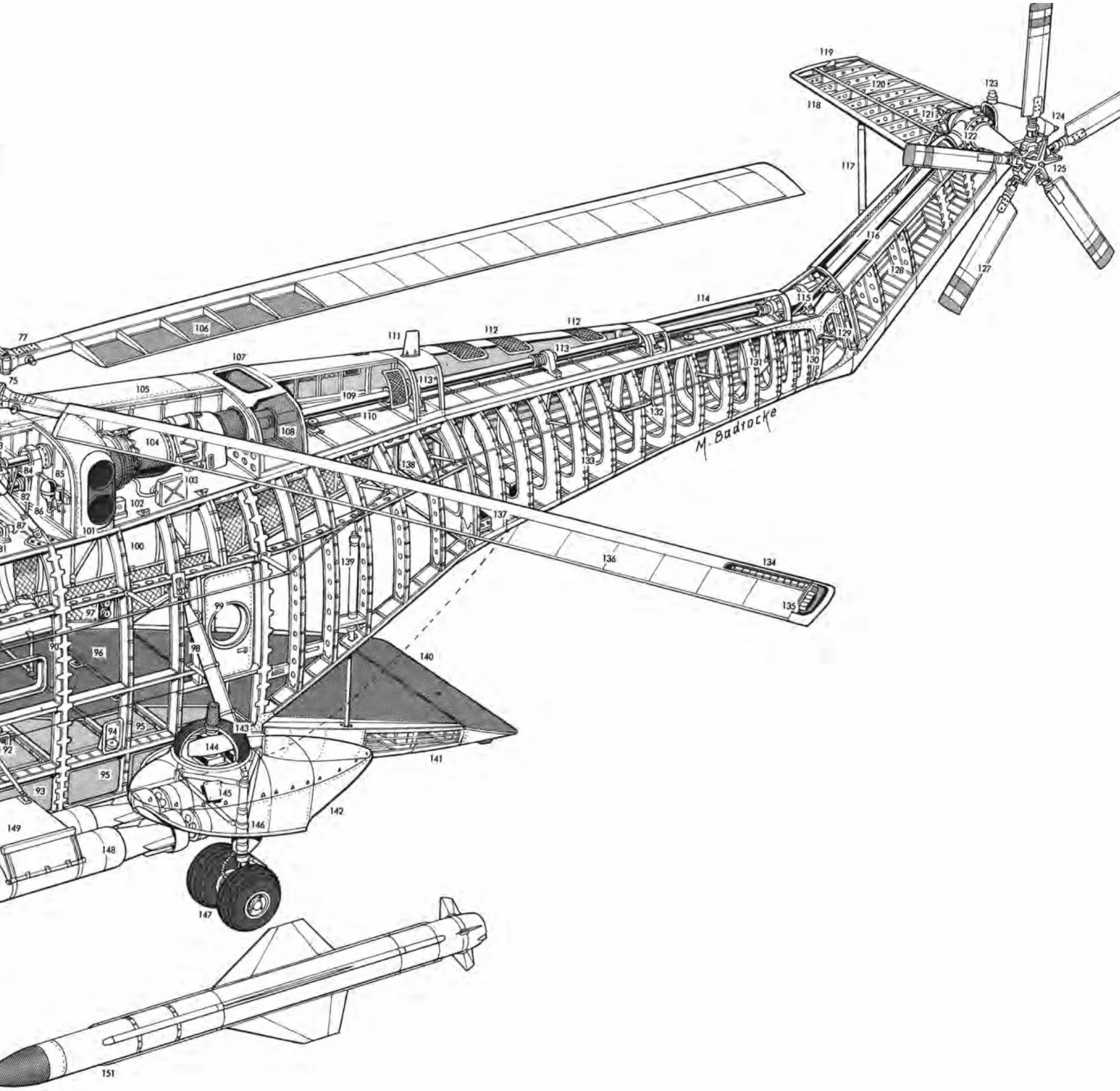
SA 321G Super Frelon

Crew: Five; up to 27 passengers
Length overall: 75ft 7in (23.03m)
Rotor diameter: 62ft 0in (18.90m)
Height: 22ft 2in (6.76m)
Empty weight: 15,130lb (6,853kg)
All-up weight: 28,660lb (13,000kg)
Powerplants: Three Turboméca Turmo IIIC7 turboshaft engines, each rated at 1,610shp (1,201kW)
Max speed: 171mph (275km/h)
Range: 633 miles (1,020km)
Service ceiling: 10,170ft (3,100m)
Armament: Four homing torpedoes, four depth charges or two Exocet missiles

Aérospatiale SA 213GM Super Frelon



1 Nose radome (Exocet-armed anti-shipping role)
2 Target designation radar scanner
3 Omera Segued ORB 32 radar equipment
4 Radome mounting fairing
5 FM homing aerials, port and starboard
6 Pitot heads
7 Windscreen wipers
8 Windscreen panels
9 Pilot's instrument console
10 Instrument panel shroud
11 Centre control pedestal
12 Cyclic pitch control column
13 Rudder pedals
14 Downward view window
15 Lower IFF aerial
16 Anti-collision light
17 Fixed steerable twin nose wheels
18 Boat hull chine member
19 Collective pitch control lever
20 Door jettison handle
21 Jettisonable cockpit doors
22 Safety harness
23 Co-pilot's seat
24 Observer's folding seat
25 Cockpit doorway
26 Sliding side window panel
27 Pilot's seat
28 Engine power levers
29 Folding sun visors
30 Overhead systems switch panel
31 Circuit breaker panel
32 Starboard side maintenance access ladder
33 Rescue hoist/winch
34 Flight control rod linkages
35 Engine control runs
36 Cabin heater
37 Heater intake grille
38 Starboard side main cabin doorway (sliding door)
39 Cockpit rear bulkhead
40 Avionics and electrical equipment racks
41 Radar altimeter equipment
42 Tie-down ring
43 Boat hull waterproof bulkheads
44 Position of pressure refuelling connection
45 Main cabin loading floor
46 Cargo tie-down rings
47 Forward group of underfloor, bag-type fuel tanks, total fuel capacity 874 Imp gal (3,975 litres)
48 Honeycomb floor panels
49 Cabin window panels
50 HF aerial rail
51 Aerial support masts
52 Fuselage frame and stringer construction
53 Cabin wall soundproof lining
54 Engine mounting deck
55 Forward engine air intakes
56 Cooling air intake
57 Starboard engine bay hinged cowling/work platform
58 Main rotor blade hollow D-section aluminium alloy main spar
59 Starboard engine exhaust fairing
60 Engine bay dividing fireproof bulkhead
61 Generator
62 Engine oil tank
63 Ignition control unit
64 Turboméca Turbo 111 C6 turboshaft engine
65 Engine transmission gearbox
66 Bifurcated exhaust ducts
67 Oil cooler fan
68 Forward engine power take-off shafts
69 Combining gearbox
70 Main reduction gearbox
71 Rotor head swash plate mechanism
72 Blade pitch control rods
73 Main rotor hub
74 Hydraulic fluid reservoirs
75 Folding rotor blade hinge joints
76 Six-bladed main rotor
77 Blade root attachment joints
78 Pressurised blade crack detection indicator
79 Rotor head hydraulic control actuator (three)
80 Hydraulic reservoir
81 Gearbox mounting deck
82 Tail rotor transmission shaft
83 Rotor brake
84 Rear engine power take-off shaft
85 Fireproof bulkhead
86 Engine fire extinguisher bottle
87 Gearbox mounting struts (four)
88 Troop seats (marine assault role), 27 troops
89 Stainless steel exhaust heat shield
90 Gearbox mounting fuselage main frames
91 Central hatch for dipping sonar or cargo hook
92 Hydraulic system ground connections
93 Central fuel tank group
94 Position of gravity fuel filters on starboard side
95 Rear underfloor fuel tank group
96 Rear cabin sloping floor section
97 Fuel pump
98 Main undercarriage upper energy absorbing strut
99 Emergency escape hatch, port and starboard
100 Troop seats folded against cabin wall
101 Aft engine
102 Fireproof engine bay decking
103 Ignition control unit
104 Aft Turboméca II C6 turboshaft engine
105 Starboard side fairing panels (aft engine on port side only
106 Main rotor blade aluminium alloy trailing-edge pocket construction
107 Aft engine air intake
108 Intake plenum
109 Tail rotor transmission shaft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110 Tail rotor control cables
111 VHF aerial
112 Venting air grilles
113 Transmission shaft bearings
114 Dorsal spine fairing
115 Bevel drive gearbox
116 Tailrotor angled drive shaft
117 Tailplane bracing strut
118 Fixed tailplane
119 Upper IFF aerial
120 Tailplane rib construction
121 Take rotor control linkage
122 Finals drive right-angle gearbox
123 Anti-collision light
124 Tal navigation light
125 Blade pitch control mechanism
126 Five-bladed tail rotor
127 Aluminium alloy tail rotor blades
128 Tail rotor pylon construction
129 Hinged pylon latch mechanism, pylon folds to starboard
130 Transmission gearbox mounting main frame
131 Internal bracing strut
132 VOR aerial
133 Tailboom frame and stringer construction
134 Main rotor blade balance weights
135 Tracking weights
136 Aluminium alloy blade skin panelling
137 IFF transceiver
138 Tailboom access hatch
139 Ramp hydraulic jacks, port and starboard
140 Cargo loading ramp (flight openable), down position
141 Ramp frame and stringer construction
142 Port stabilising float
143 Port lateral radome
144 ASW search radar scanner
145 Main undercarriage lower mounting struts
146 Shock absorber leg strut
147 Fixed twin mainwheels
148 L5 1,000kg homing torpedoes (four)
149 Twin torpedo carrier/launcher
150 Dipping sonar (ASW operations)
151 AM 39 Exocet anti-shipping missile (two)

HMM-364 'Purple Foxes' (motto: "Give A Shit") was the last West Coast 'Phrog' squadron. One of its CH-46Es is seen landing on the USS Peleliu in 2012. Cpl. *Timothy Childers/USN*

Boeing-Vertol H-46 Sea Knight

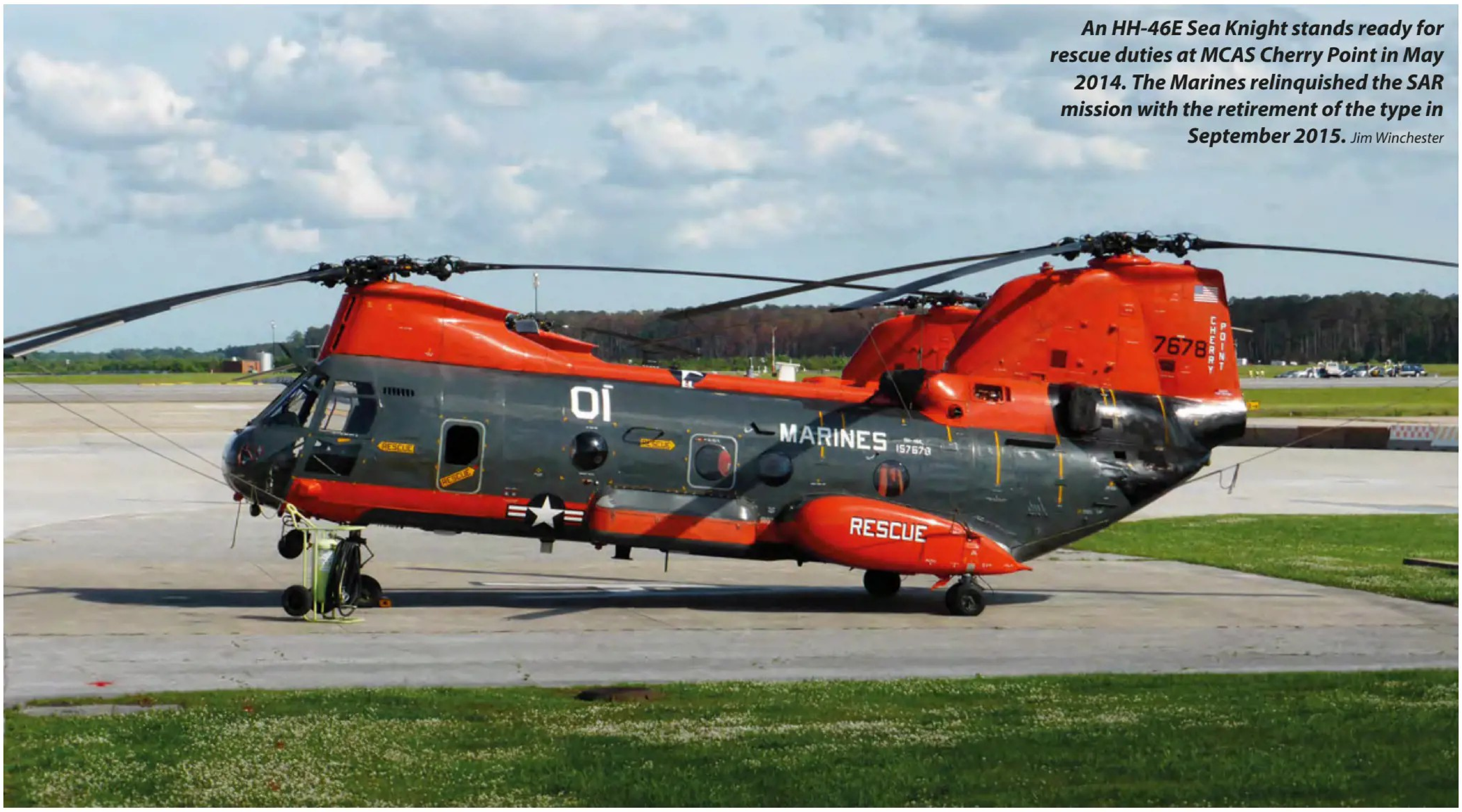
The Phrog

Combat assault, vertical replenishment and search-and-rescue were the main missions of the long-lived Sea Knight.

A prototype V.107 or Model 107 flew in April 1958. It was intended to prove the concept for the company's submission to the US Army's heavy lift helicopter competition. This resulted in the YHC-1A, which would eventually evolve into the CH-47 Chinook. The Model 107-II was marketed as a civil aircraft and had some success, selling to commercial operators including New York Airways

Vertol was acquired by Boeing in 1960 and around this time the US Marines issued a requirement for a helicopter able to carry a 4,000lb (1,814kg) load or 25 fully equipped troops to an objective 115 miles (185km) away and back at a speed of 150mph (241km/h) and Boeing-Vertol, as the new entity was known, offered a version of the V.107. The militarised Model 107M had uprated 1,250shp (930kW) T58-GE-8B engines, automatic blade folding and an integrated loading system. It was declared

A camouflaged CH-46E of HMM-161 'Greyhawks' refuels at Jubail Naval Airport, Saudi Arabia during Operation Desert Storm in 1991. *Master Sgt. H. Gray/USMC*



An HH-46E Sea Knight stands ready for rescue duties at MCAS Cherry Point in May 2014. The Marines relinquished the SAR mission with the retirement of the type in September 2015. *Jim Winchester*

the winner of the Pentagon's assault helicopter contract in February 1961, partly because Boeing offered a fixed price for 200 HRB-1s on the basis that they would sell 300 more to other customers. In the end, 677 were produced for US forces up to 1977 and 121 were assembled for the Japanese Self-Defense Forces by Kawasaki. Other export users are outlined below.

The designation changed to CH-46A Sea Knight in 1962 and service entry began with HMM-265 in June 1964. The conflict in Vietnam was escalating and the twin-rotor helicopter became the Marines' primary 'battle taxi' throughout the conflict. Combat losses in Southeast Asia amounted to 109 CH-46As and 87 CH-46Ds, although many others were badly damaged and recovered.

The US Navy adopted the type for a very different role, that of vertical replenishment (VertRep). In 1964 they ordered six UH-46As, using them aboard combat supply ships to transfer ammunition and other supplies to smaller warships. More followed as UH-46Ds, based on the CH-46D for the Marines, which had redesigned main rotor blades and T58-GE-10 engines. The CH-46E was a re-engined version for the Marines, 300 CH-46As and 'Ds being given 1870shp (1,395kW) T58-GE-16 engines, improved avionics and survivability upgrades including self-sealing fuel tanks and armoured pilot's seats. The CH-46F was another avionics upgrade. There were also a few RH-46As modified for mine-hunting.

Kawasaki in Japan acquired a licence to produce the type, which was usually known as the KV-107. There were only nine built for the JMSDF and in the inventory from 1963-1990, while another 60 served with the JGSDF from 1966-2002 and 52 with the JASDF (1967-2009). Others were sold to commercial operators such as Tokyo Airways.

In a rare example of Japan exporting military equipment, ten were sold to Sweden as Hkp 4Bs in 1973, adding to eight Hkp 4As (UH-46Bs) purchased a decade earlier. They were mainly used by the navy (*Marinen*) on land-based ASW and transport work, although also for fire-fighting and other tasks. Their main task was hunting Soviet submarines in the Baltic Sea and they were prominent during the 'Whiskey on the Rocks' incident in October 1981 when a Soviet 'Whiskey'-class submarine grounded near the Karlskrona naval base. It had possibly been observing test drops of new Type 42 torpedoes by Hkp 4s. The Soviet captain was flown to the base by an Hkp 4 during the incident. The Hkp 4s later came under control of the air force (*Flygvapnet*) and were finally retired in 2011.

Canada acquired 18 examples, beginning with CH-113 Voyageur transports for the Army in 1963. The RCAF operated the CH-118A Labrador for SAR work. With the merger into Canadian Forces, both variants were upgraded to a similar SAR standard. They were replaced by the CH-149 Cormorant from 2001.

USMC Sea Knights, nicknamed 'Phrogs' due to their squat appearance when viewed head-on, continued in service into the 2010s. They supported operations in Lebanon in the early 1980s and the invasion of Grenada in 1983, airlifting troops to capture Pearls Airport and conducting the rescue of an AH-1 pilot under fire. CH-46s participated in operations Desert Storm, Enduring Freedom and Iraqi Freedom. The last reported combat loss was in April 2007, when insurgents downed a CH-46E near Falujah with a missile.

CH-46s were part of the Presidential support fleet, carrying staffers and journalists on international tours from 1962 until 2014. The final military users were USMC SAR flights. ■

CH-46D Sea Knight

Crew: Three and up to 25 troops
Fuselage length: 45 ft, 8 in (13.19m)
Rotor diameter: 50ft (15.24m)
Height: 16ft 8in (5.08m)
Empty weight: 13,065lb (5,926kg)
All-up weight: 23,000lb (10,432kg)
Powerplant: Two General Electric T-58-GE-10 turboshaft engines, each rated at 1,400hp (
Max speed: 165mph (266km/h)
Range: 230 miles (370km)
Service ceiling: 13,100ft (3,993m)
Armament: Two GAU-15/A 0.50in door-mounted machine-guns, one ramp-mounted M240D 7.62mm machine-gun

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MARINHA N 7017

N-7017 was delivered in April 1966 to the Brazilian Navy as one of 11 UH-2s. *Leonardo*

Westland Wasp

Small Stinger

Developed alongside the land-based Scout, the diminutive Wasp provided a helicopter capability to several navies with smaller warships.

Development was initiated by Saunders-Roe (Saro), who saw the potential of a turbine-powered light helicopter to replace the Skeeter then in service with the Army Air Corps. Several prototype P.531s were built, the first two with 425shp (Blackburn-Tuboméca Turmo engines and three more with the 960shp (716kW) Blackburn A.129 Nimbus. In 1959 Westland acquired the Saro Helicopter Division and continued development with the de Havilland Gnome rated at 685shp (511kW). A batch of P.531-2 Mk. 1s was ordered in 1960, quickly followed by a production order for 40 Scout AH.1s for the Army. The Royal Navy showed an early interest in the design and tested P.531s aboard ships with a variety of undercarriage arrangements, including skids with suction cups or with oleo legs or wheels. Eventually a four-wheeled undercarriage was chosen. The front wheels were toed inwards and the rear wheels toed outwards for stability on landing platforms and a harpoon-type system was used to lock the aircraft to the deck.

A Royal Navy Wasp fires an AS.12 wire-guided missile. XT421 was later sold to Malaysia as M499-03.

Avionics were simple, with no sonar or MAD, the Wasp relying on guidance from its ship to vector it towards a submarine or surface contact. An autostabilisaton system and radio altimeter allowed precise hovering for a depth charge attack. Other weapons included up to two Mk 44 torpedoes or one heavier Mk 46; SS.11 or AS.12 wire-guided missiles or a WE.177A nuclear depth bomb. The procedure for using this 600lb (272kg) weapon, which had to be mounted diagonally under the fuselage, required leaving the cabin doors and crewman behind. When the weapon was dropped, the pilot turned in the direction of the strongest tailwind and left the scene as fast as possible, which at a maximum 104 knots

Wasp NZ3901 prepares to land aboard the frigate HMNZS Canterbury. This helicopter ditched in 1993 but was recovered and is now in private hands.

Air Force Museum of New Zealand

RNZN
NZ3901
CANTERBURY
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(120mph/193km/h) wasn't guaranteed to get the helicopter to a safe distance.

A prototype Wasp flew on 28 October 1962 and the HAS.1 entered Royal Navy service with No. 700W NAS, the Intensive Flying Trials Unit at Culdrose in June 1963, followed by No. 829 NAS, the headquarters squadron for the Small Ships Flights, and training unit No. 706 NAS.

By the time of the Falklands War Wasps were detached to the remaining 'Leander'- and 'Rothesay'-class frigates, and to HMS *Endurance,* the Royal Navy's ice patrol ship and 'Hecla'-class survey vessels. During the conflict, three Wasps were configured as air ambulances with red cross markings and carried casualties and medical supplies. Others were used to insert Special Forces ashore and conduct naval gunfire support missions. Their most famous contribution came during the recapture of South Georgia when Wasps from *Endurance* and Plymouth struck the Argentine submarine ARA *Santa Fe* with four of eight AS.12s fired, preventing it from diving. No Wasps were lost in the course of the war.

As older ships were retired and the more capable Lynx took over the Small Ships Flights role, the Wasp was progressively retired, leaving RN service in 1988.

Westland built 134 Wasps and six other navies operated the type. South Africa ordered its first Wasps in 1962, eventually receiving 16, although the last batch was delayed by an arms embargo in 1974 and a 17th aircraft was never delivered. At least six were written off in service, one of them going down with the frigate SAS President Kruger after a collision with an oiler. The survivors were retired 1990.

New Zealand purchased three new Wasps in 1966 and added as many as 15 more over the years although some were acquired as spares sources. They operated mainly from the RNZN's 'Leander'-class frigates but also from land including peacekeeping operation Belisi in Bouganville in 1997 when at least one was painted in high-visibility orange. The remaining airworthy examples were sold back to Westlands that year. Brazil bought three new Wasps in 1966 and a further seven ex-RN airframes in 1977. They served on the 'Gearing'- and 'Allen M. Summer'-class destroyers and at least four were still in service in 1991.

The Netherlands operated 13 Wasps as the AH-12A from 1966. In 1981, ten of these were refurbished by Westlands and sold to Indonesia, adding to four new-build examples acquired the same year. Malaysia's Navy bought 12 ex-RN Wasps in 1987-1990 and were the last military operator, retiring the type in September 2002. ■

Westland Wasp HAS.1

Crew: Two; up to four passengers
Fuselage length: 30ft 4in (9.24 m)
Rotor diameter: 32ft 3in (9.83 m)
Height: 8ft 11in (2.72m)
Empty weight: 3,452lb (1,566kg)
All-up weight: 5,500lb (2,495kg)
Powerplant: One Rolls-Royce Nimbus 103 turboshaft engine, rated at 710shp (530kW)
Max speed: 120mph (193km/h)
Range: 303 miles (487km)
Service ceiling: 12,200ft (3,700m)
Armament: Two Mk 44 or one Mk 46 torpedo; two Mk 11 depth charges or one WE.177 nuclear depth bomb; two AS.12 missiles or four AS.11s; one 7.62mm machine-gun

A CH-53A Sea Stallion lifting supplies at Landing Zone Stud in South Vietnam in 1968. The base was vital for supporting the beleaguered Marine base at Khe Sanh.
NARA

Sikorsky S-65/S-80 H-53 Sea Stallion/Sea Dragon

Big Iron

The largest Western helicopter ever built, the Sea Stallion served in transport, rescue, minesweeping and other roles. First flown in 1964, its legacy continues with the King Stallion, which is slowly replacing it in the Marine Corps.

Development of the CH-53 can be traced to October 1960 when the Marines submitted a requirement for a replacement for the HR2S-1 (CH-37 Mojave) heavy transport helicopter. The piston-engined Mojave was not very reliable and could lift only 6,673lb (3,026kg) but showed the value of helicopters able to lift vehicles as part of a beach assault

An attempt at a tri-service VTOL transport produced the Vought-Hiller-Ryan XC-142A, but no production aircraft, and in March 1962 the Navy issued a requirement for a heavy experimental helicopter or HH(X). This was to be able to carry a truck and trailer or a Hawk SAM battery or Honest John missile launcher.

The first flight of a YCH-53A prototype took place on 14 October 1964 at Stratford, Connecticut. The S-65 design took the transmission system of the S-64 (CH-54 Skycrane) and the rotors of the S-56 (CH-37 Tarhe) and married them to a new fuselage upscaled from that of the S-61 (H-3). It was able to carry 38 troops or 24 casualty litters.

A need to supplement HH-3Es in the combat SAR role in Vietnam saw the USAF adopt the HH-53C variant with a refuelling probe and additional armour. It quickly became known as 'The Jolly Green Giant' and proved longer-ranged and more survivable, although 14 USAF CH/HH-53s were lost in Southeast Asia, one of them shot down by a MiG-21.

Marine CH-53As entered service with November 1966 with HMM-463 and first deployed to Vietnam in January 1967. They served throughout the war, transporting troops and resupplying isolated outposts. Losses amounted to 19 CH-53As, several of them destroyed in sapper attacks on their bases.

Although all CH-53As could be fitted with minesweeping equipment, the Navy realised that a dedicated airborne mine countermeasures (AMCM) capability would require more power for safety, so 15 were re-engined with 3,925shp (2,928kW) T64-GE-413 engines, a guide frame on the rear ramp and rear-view mirrors. These RH-53As saw action in Operation End Sweep at the end of the Vietnam War, de-mining Haiphong harbour. Various types of sled would be towed at 28mph (45km/h) on a 450ft (140m) cable to bring up mines, which would then be destroyed by machine-guns fired from the side doors. Successful trials saw the ordering of 30 RH-53Ds with increased power from 4,380shp (3,268kW) T64-GE-14 engines, an inflight refuelling probe, external fuel tank capability and an advanced automatic flight control

An anonymous RH-53D aboard USS* Nimitz *before the ill-fated April 1980 'Eagle Claw' mission to rescue US hostages held in Iran. Six of the eight helicopters were lost during the operation. *NARA*

Personnel boarding an MH-53E Sea Dragon of HM-14 during training aboard USS* Enterprise *in September 2011. Note the large fuel sponsons on this variant. *US Navy*

system. Six RH-53Ds were delivered to the Imperial Iranian Navy, and the version gained notoriety, not with the post-revolutionary armed forces, but when USN RH-53Ds took part in Operation Eagle Claw, the attempt to rescue US hostages held in Tehran in April 1980. The operation ended in disaster, with three RH-53Ds pulling out en route and one colliding on the ground with a C-130 at the 'Desert One' airstrip. Five intact RH-3Ds were left behind when the mission was abandoned.

One problem with the CH-53 was that it was too heavy to recover if it was broken down or damaged in the field. The Marines wanted a helicopter that could lift an 18-ton (16,340kg) load. The Army had a separate need for a helicopter with 22-ton (19,958kg) lifting capacity. There was an attempt to merge the programmes, but the designs that emerged were too small for the Army and too large for the Marines, which had to consider the limited space aboard Navy amphibious ships. Each service went its own way, with the USMC getting approval for an improved 'Super Stallion' in 1978. It was nine years from production go-ahead until delivery of the first CH-53E (S-80), which added a third engine and a seven-bladed main rotor. The Marines and Navy

The mine-hunting equipment including mirrors can be seen on this JMSDF S-80M-1 Departing MCAS Iwakuni in October 2015.

Jim Winchester

The CH-53K is still not fully operational with the USMC a decade after its first flight. This one was being used for training by HMHT-302 at Camp Lejeune, North Carolina in 2025. *Lance Cpl. James Brisker/USMC*

acquired 177 CH-5Es, the Navy operating small numbers for VOD (vertical on-board delivery).

The MH-53E Sea Dragon was a combination of the CH-53E airframe with the minesweeping gear of the RH-53D. When first flown in December 1983 it looked identical to the CH-53E, but large sponsons were soon added, increasing fuel capacity to 3,200 US gal (12,113 litres). This permitted minesweeping missions of up to four hours duration at 30 minutes distance from base. For self-deployment, the MH-53E could carry additional internal fuel tanks and retained the refuelling probe of the CH-53E. Deliveries began to three squadrons from April 1988. They were used both in the AMCM and VOD roles. HM-14 deactivated in 2023, but HM-15 remains active, with a mission of providing worldwide minesweeping within 72 hours. The Marines retired the twin-engined Sea Stallion in February 2012 when VMM-363 handed over its last CH-53D. The CH-53 'Echo' remains in service with seven USMC squadrons.

Sea Stallions and their derivatives have been flown by five other countries. Germany bought two CH-53Gs in 1968, assembled 20 more from Sikorsky-supplied kits and built a further 90 under licence. About 80 modernised CH-53GSs are still in use by the Luftwaffe.

Iran's six RH-53As were down to two flyable examples by 1988, but somehow the IRIN has been able to keep five airworthy and three fully operational into the 2020s,

Unable to get additional Super Frelons because of a French arms embargo, Israel purchased 33 S-65C-3s, similar to the CH-53C, in 1969. Named Yas'ur (petrel), they have seen much action and 22 remain in service. Austria bought two new C-53Ös (for Österreich) in 1970, mainly for support in emergency situations, but they were expensive to operate and were sold to Israel in 1981.

Japan selected the S-80M-1 as a replacement for its KV107-II minesweeper helicopters in 1983. The first of 11 was not delivered until 1989. They were retired in March 2017 and replaced by (M)CH-101 Merlins.

Efforts to replace the Sea Stallion culminated in the CH-53K King Stallion, which made its first flight on 25 October 2015 at West Palm Beach, Florida. Although outwardly similar to its predecessors, the King Stallion has three General Electric T408-GE-400 engines which produce 7,500shp (5,595kW) each, permitting triple the payload of a CH-53D. It has a modern 'glass' cockpit, a fly-by-wire flight control system and many improvements to its cargo handling and survivability.

To date, 15 CH-53Ks have been delivered out of a 'Program of Record' of 200 aircraft with an average acquisition cost of $135.8m per unit. Initial operational capability (IOC) was declared in April 2022. The first operational unit is HMH-461 'Iron Horses' at MCAS New River, North Carolina

Israel has ordered 12 CH-53Ks as the Pereh (wild ass), with deliveries expected in 2028. Germany chose the CH-47F as its CH-53GS replacement in 2022. ■

Sikorsky RH-53D Sea Stallion

Crew: Three; capacity for 55 troops
Fuselage length: 88ft 3in (26.90m)
Rotor diameter: 72ft 3in (22.02m)
Height: 24ft 11in (7.60m)
Empty weight: 22,444lb (10,180kg)
All-up weight: 42,000lb (19,050kg)
Powerplant: Two General Electric T64-GE-415 turboshaft engines, each rated at 4,380shp (3,266kW)
Max speed: 196mph (315km/h)
Range: 257 miles (414km)
Service ceiling: 21,000ft (6,400m)
Armament: Two 0.50in machine-guns in window mounts

The Sea King HC.4 was known as the 'Jungly', but was often found in the mountains of northern Norway, conducting the annual 'Clockwork' cold weather exercises with the Royal Marines.

POA(Phot) Mez Merrill/Crown Copyright

Westland Sea King

Built in Britain, Sold Worldwide

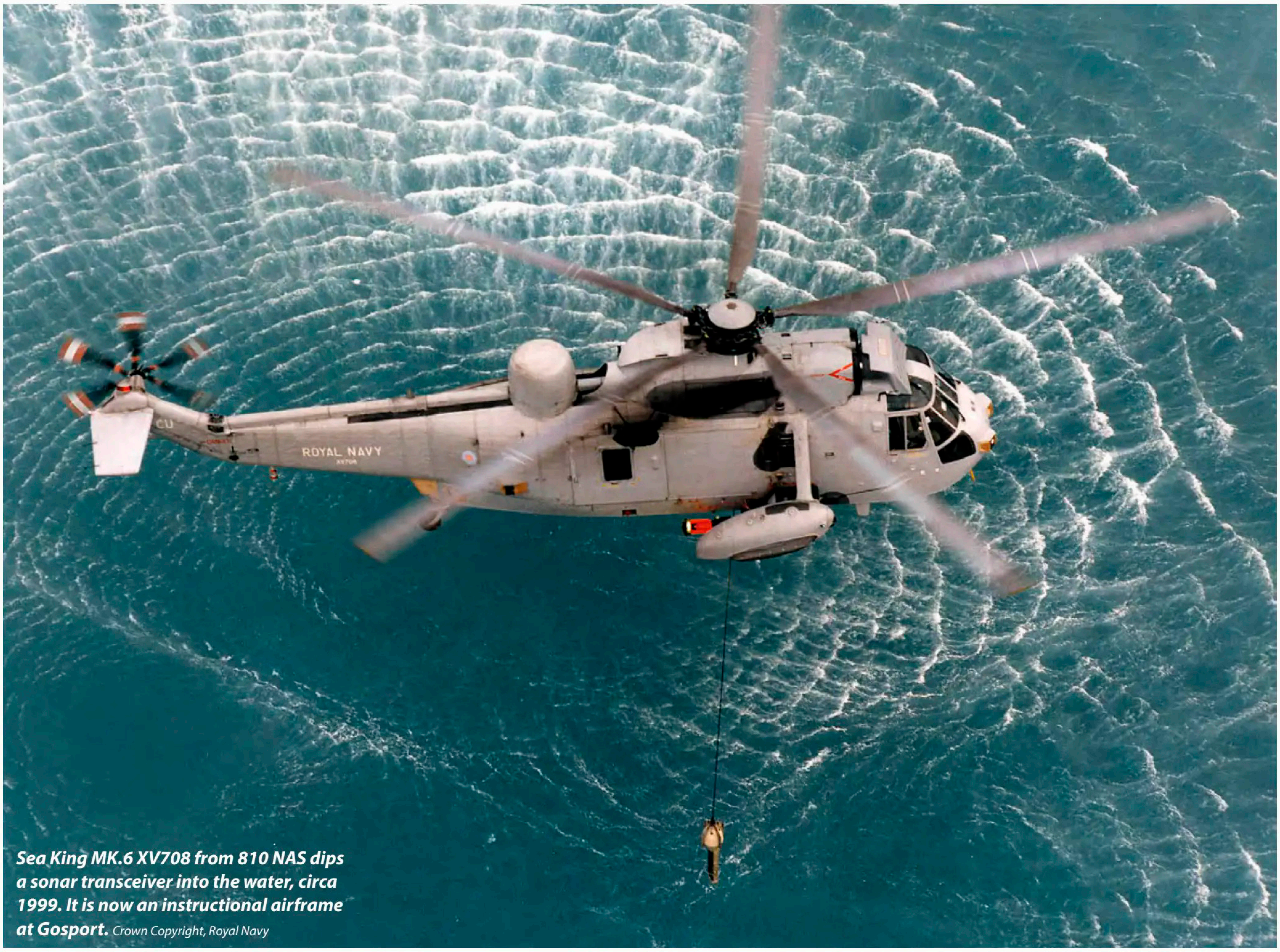
Licence-built by Westland, the Sea King had greater export success than the Sikorsky original and remains in service with several nations in ASW, anti-shipping and transport roles.

In mid-1966 a Westland-built version of the Sikorsky S-61 was selected by the Royal Navy as its next anti-submarine helicopter to replace the company's Wessex. Westland acquired four SH-3Ds (three as kits) from Sikorsky, the first arriving at the manufacturer's airfield at Yeovil in October 1966. The company introduced several changes to the Sikorsky S-61D airframe and systems, including installing Rolls-Royce Gnome H1400 turboshafts instead of General Electric T58s, the ARI5995 search radar, a new sonar and an automatic flight control system. The three kits were assembled with the changes incorporated and were used for development work.

A total of 56 production Sea King HAS.Mk 1s followed, the first flying on 7 May 1969. Sea Kings were initially delivered to the Intensive Flying Trials Unit (IFTU), No.700S NAS, in August 1969, which existed until the end of May 1970. No. 706 NAS, the Advanced Flying Training Squadron, received its first Sea Kings in January 1970, followed by the Anti-Submarine Operational Flying School (No.737 NAS) at RNAS Portland in July.

Five frontline squadrons were equipped with Sea King HAS.Mk 1s. The first was No. 824 NAS, which reformed on 24 February 1970 and embarked on HMS *Ark Royal* on 12 June. It spent most of its time at sea with the carrier, operating from its decks until the warship was withdrawn in 1978. The second was No. 826 NAS, which supported HMS *Eagle* until 1972, while No. 819 NAS was based at Prestwick Airport to provide ASW support to the submarine base on the Clyde. Sea Kings for the helicopter cruiser HMS *Blake* were provided by No. 820 NAS, which reformed December 1972, while in March 1973 No.814 NAS was commissioned to operate from HMS *Hermes*.

Seen here with a full load of torpedoes, XV371 was one of four Sikorsky SH-3Ds used as a trials and pattern aircraft. It was last seen at the Glastonbury Festival.



Sea King MK.6 XV708 from 810 NAS dips a sonar transceiver into the water, circa 1999. It is now an instructional airframe at Gosport. *Crown Copyright, Royal Navy*

More powerful versions of the Gnome engine, plus a six (rather than five) blade tail rotor, were introduced on the HAS.Mk 2. The variant also had improved avionics and dipping sonar, while air intake guards were fitted to the majority of the aircraft. Twenty-one new airframes were built as HAS.Mk 2s, while at least 45 Mk 1s were upgraded to a similar standard as HAS.Mk 2As. They began to replace the Mk 1s with the five frontline units from 1976 – initially going to No. 826 NAS – and the last Mk 1s had left service by July 1978.

The Sea King HAS.Mk 5 first flew on 14 August 1980. It featured a major upgrade of the avionics, introduced the Sea Searcher radar in a larger dorsal radome and Orange Crop electronic support measures (ESM), as well as new sonobuoy deployment and acoustic processing equipment. An order was placed for 30 new Sea King HAS.Mk 5s and over 50 earlier airframes were upgraded. They entered service with No. 820 NAS, which initially deployed two aboard HMS *Invincible* on 18 November 1980, which were joined by the rest of the unit's complement in February 1981. The Sea King HAS.Mk 5s of Nos 820 and 826 NASs were deployed aboard HMS *Invincible* and *Hermes* with the task force to recapture the Falkland Islands, along with four HAS.Mk 2s of No. 824 NAS, which operated from RFA *Olmeda* and *Fort Grange*. In addition, No.825 NAS was reformed for the conflict on 7 May 1982 with HAS.Mk 2s, mainly operating from SS *Atlantic Causeway* in the troop transport and heavy lift roles in the South Atlantic. It disbanded on 17 September 1982. No. 810 NAS reformed on the new variant on 15 February 1983 to take over the role of training Sea King crews from No.737 NAS. The last unit to re-equip with the Mk 5 was No. 819 NAS at Prestwick.

The final ASW Sea King variant to enter service, the HAS.Mk 6, introduced composite main rotor blades, a fully integrated tactical mission system, new avionics, sonar and processing equipment, better communications and Orange Reaper ESM gear. A total of 69 conversion kits were ordered, but only around 54 used, the first flying on 15 December 1987. In addition, five new HAS.Mk 6s were built. Initial examples went to No. 824 NAS, the IFTU for the variant, and they went on to serve with Nos 771, 810, 814, 819, 820 and 826 NASs. Sea King HAS.Mk 6 regularly deployed on the three 'Invincible'-class carriers in the 1990s. No. 820 NAS was the last to fly the Sea King in the ASW role, retiring the helicopter in March 2003.

It was with the Commando Helicopter Force that the Sea King saw most action. The variant could accommodate up to 28 troops in the cabin, had a fixed landing gear without sponsons and provision for a pintle-mounted machine-gun in the door. The first flew on 26 September 1979. A total of 40 Sea King HC.Mk 4s were built, later augmented by the conversion of a single Mk 4X.

The first unit to fly the HC.Mk 4 was No. 846 NAS, which began to replace its Wessex HU.Mk 5s during December 1979, deploying at sea for the first time aboard HMS *Bulwark* in April 1980. It was embarked on HMS *Hermes* during the Falklands campaign.

No. 845 NAS re-equipped with Sea King

A Norwegian Sea King Mk. 43B lowers a person to a CB90 fast patrol boat during a 1998 exercise. This aircraft is now an instructional airframe at Sola. Torbjørn Kjosvold/Forsvaret

HC.Mk 4s after the conflict, while the helicopter was also issued to No. 707 NAS, the commando training unit, in October 1983.

No. 848 NAS reformed on 16 November 1990 for service during the first Gulf War. It disbanded on 19 April 1991, but emerged again in March 1995 to take over the commando training role.

No. 846 NAS stood down in the summer of 2013 and was amalgamated into No. 845 NAS, which began transition to the Leonardo Merlin HC.Mk 3 during July 2015. To maintain a capability with the Sea King HC.Mk 4s, No. 848 reformed again on 1 May 2015. When it was decommissioned on 24 March 2016, it ended the long association of the Royal Marines with the 'Junglie' Sea King.

Sea King HC.Mk 4s were active in nearly every military campaign involving British troops from the early 1980s. Among the operations they participated were both the 1991 and 2003 Gulf Wars, as well as Operation Haven in Turkey and northern Iraq; they served in Northern Ireland; the multiple conflicts that followed the breakup of Yugoslavia; the brief campaign in Sierra Leone, and the war in Afghanistan.

The last frontline role for the Sea King was adopted was that of airborne early warning (AEW). The Sea King AEW.Mk 2A was the result of an urgent programme begun in May 1982 to provide the fleet with an AEW capability. For the role the helicopter was equipped with a Searchwater radar mounted on a rotating arm on the starboard side of the rear fuselage, its radome within an inflatable envelope – giving rise to the variant's 'baggie' nickname.

Nine Mk 1/2s were initially converted, with the first pair of prototypes handed over to D Flight of No. 824 NAS and rushed to the South Atlantic on HMS *Illustrious* from 2 August 1982 in the wake of the Falklands conflict. Four additional HAS.Mk 5s were later converted as AEW.Mk 2s for the reformed No. 849 NAS.

The helicopters were later upgraded with a Searchwater 2000, JTIDS datalink and a new central tactical system as Sea King ASaC.Mk 7s (briefly AEW.Mk 7s), the airframes returning to service from May 2002 after modification.

The squadron's flights operated from all three Invincible-class carriers, providing AEW coverage for the fleet as well as supporting combat operations over the Balkans and Iraq. The last three Sea King ASaC.Mk 7s to be retired on 26 September 2018.

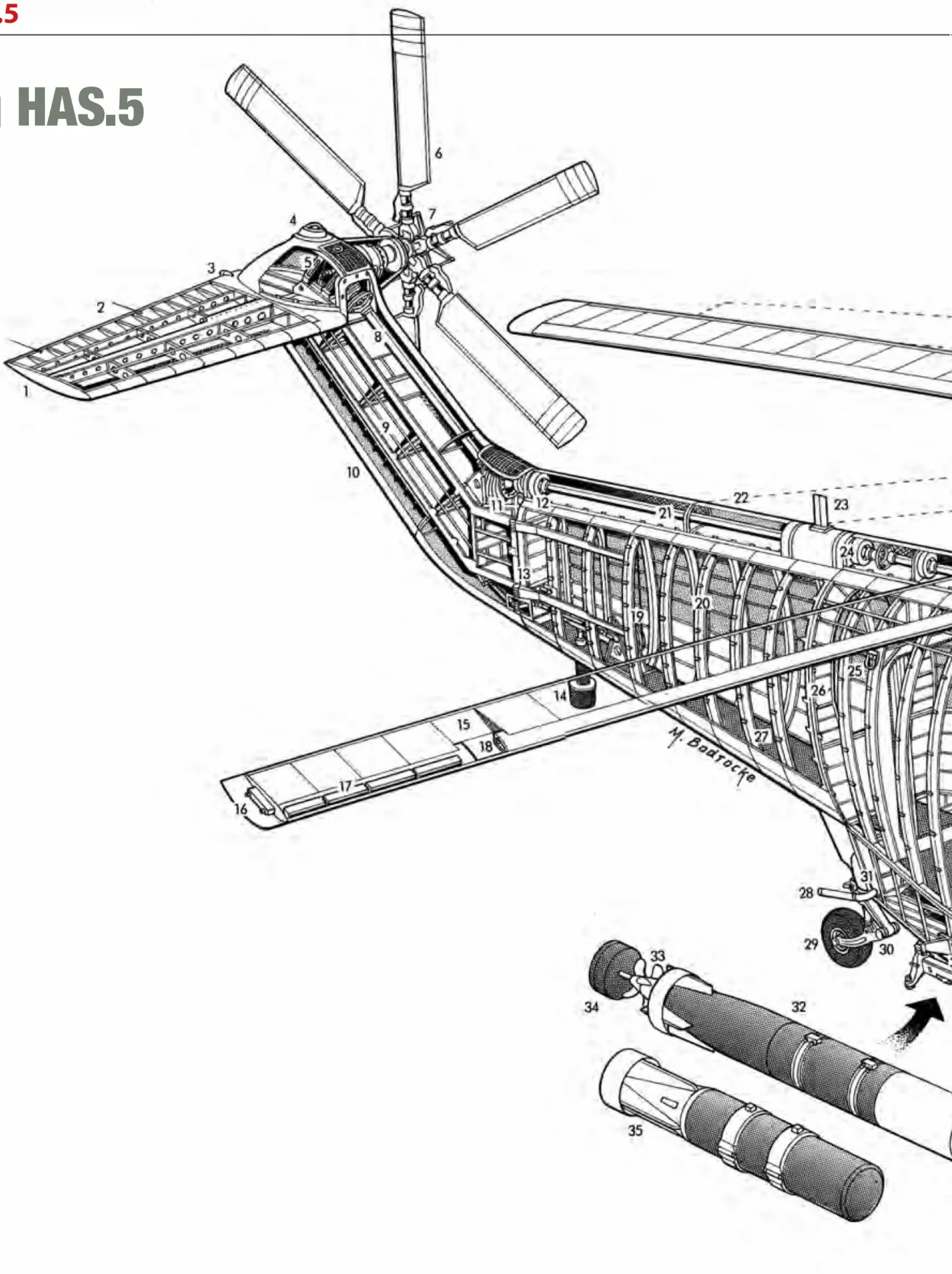
Westland-built Sea Kings operated with more air arms than did their Sikorsky cousins. First was West Germany's Bundesmarine, which purchased 22 Mk. 41s, based on the HAS.1, in 1969, taking delivery from 1972. Initially used in the SAR role, they were later equipped for anti-surface warfare with Seaspray radar and Sea Skua missiles. The last eight were retired in August 2024. India's Navy ordered six Mk. 42s in 1969 and eventually operated a total of 43 Sea Kings including six Mk. 42As, 21 Mk. 42Bs with Sea Eagle missile capability and six Mk. 42Cs for SAR and transport. Norway's 14 were Mk. 43s, mostly operated as rescue aircraft from 1972 to 2023. Egypt's 24 transports were designated Commando Mk.1 and Mk. 2. Delivered from 1975, most are believed to still be in service. A further six Mk. 47s went to the Egyptian Navy for ASW duties. Some of Pakistan's 17 Mk. 45s were equipped to employ the Exocet anti-ship missile. In 2017 Pakistan received seven ex-RN HC.4s and about 19 Sea Kings remain in the inventory. Belgium's five Mk. 48s rescued more than 1,700 people in their career from 1976-2019. The Royal Australian Navy purchased ten Mk. 50s in 1973 and two Mk. 50As in 1981, using them for ASW, SAR and utility missions until 2011. Qatar's four Commando Mk. 2s, one of which was in VIP configuration, and eight Mk. 3s, which could be armed with rockets, gun pods or Exocets, were delivered in 1976 and 1982-84, respectively, and ten aircraft were sold to Pakistan in 2021.

Most recently, three ex-UK and six German Sea Kings have been supplied to Ukraine, where they are operated by the Marine Aviation Brigade in the war with Russia. ■

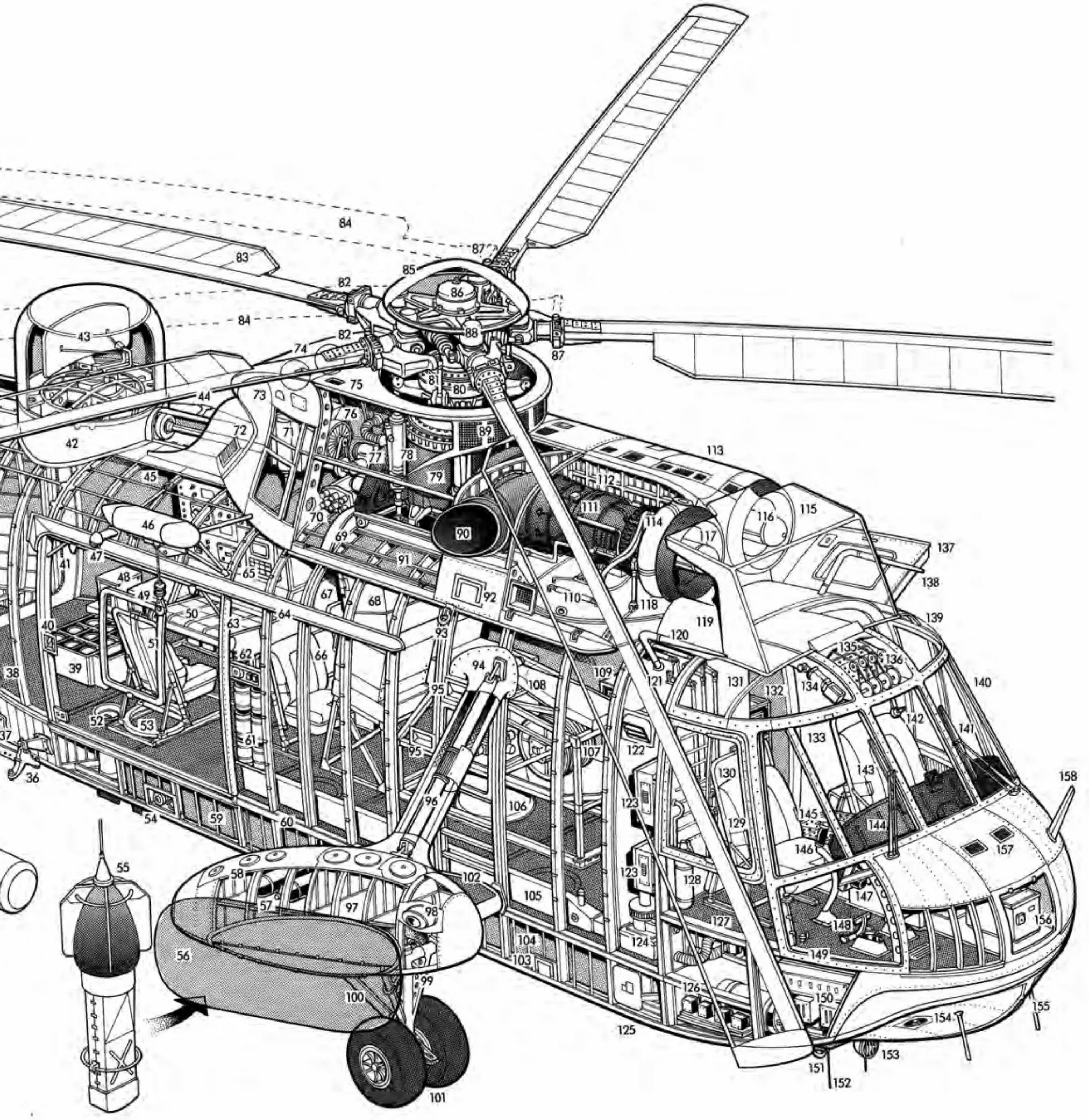
Westland Sea King HAS.Mk 1

Crew: Four (two pilots, one observer, one sonar operator)
Length: 55ft 10in (17.01m)
Rotor diameter: 62ft 0in (18.90m)
Height: 16ft 1in (4.91m)
Empty weight: 12,170lb (5,520kg)
Max T/O weight: 20,500lb (9,300kg)
Powerplant: Two Rolls-Royce Gnome H turboshafts, each of 1,500shp (1,119kW)
Max speed: 129mph (207km/h)
Range: 690 miles (1,111km)
Service ceiling: 10,500ft (3,200m)
Armament: Four Mk 44 torpedoes, four Mk 11 depth charges, one WE.177 or B57 nuclear depth charge

Westland Sea King HAS.5



1 Fixed tailplane construction
2 Static dischargers
3 Tail navigation light
4 Anti-collision light
5 Tail rotor gearbox
6 Six-bladed tail rotor
7 Blade pitch change mechanism
8 Tail rotor drive shaft
9 Tail pylon construction
10 Glassfibre trailing-edge panel
11 Intermediate shaft gearbox
12 Shaft coupling
13 Folding tail pylon hinges
14 Transponder aerial
15 Rotor blade cross section
16 Blade tracking weight
17 Blade balance weights
18 D-section aluminium spar
19 Tail rotor control gear
20 Tailcone frame and stringer construction
21 Tail rotor tranamission shaft
22 Dorsal spine fairing
23 UHF aerial
24 Shaft bearings
25 Tie-down ring
26 Fuselage/tailcone production joint
27 Maintenance walkway
28 Fuel jettison pipe
29 Non-retracting tailwheel
30 Tailwheel levered suspension leg strut
31 Tailwheel castoring leg fixing
32 Mk. 46 torpedo
33 Torpedo propellers
34 Parachute launch pack
35 Mk. 11 depth charge
36 Weapon pylon shackles
37 Weapon release unit (four)
38 Cabin flooring
39 Smoke marker container
40 Door latch
41 Cabin rear bulkhead
42 Radar scanner support mounting
43 MEL Sea Searcher radar scanner
44 HF aerial cable
45 Cabin wall soundproofing panels
46 Rescue hoist/winch
47 Winch floodlight
48 Transponder transmitter/receiver
49 Radar transmitter/receiver
50 Data processing station (Marconi LAPADS)
51 Crew emergency exit window
52 Sonobuoy launch tube
53 Swivelling seat mounting
54 Pressure refuelling connection
55 Plessey Type 195 dipping sonar
56 Emergency flotation bag (shown inflated)
57 Flotation bag inflation bottles
58 Bilge pump access covers
59 Underfloor fuel tanks, total fuel capacity 704 imp gal (3,200 litres)
60 Fuselage main longeron
61 Sonobuoy stowage racks
62 Winch operating control lever
63 Sliding freight door
64 Freight door rail
65 Data display panels
66 Sonar operator's seat
67 Portside radar observer's seat
68 Sonar/radar instrumentation racks
69 Gearbox mounting support structure
70 Hydraulic system connectors
71 Oil cooler
72 Oil cooler air outlet
73 Rotor head tail fairing
74 Engine fire extinguisher bottles
75 Handhold
76 Oil cooler fan
77 Gearbox-driven accessory units
78 Rotor head hydraulic control jack (three)
79 Main gearbox
80 Swash plate mechanism
81 Blade pitch control rods
82 Blade attachment joints
83 Master (non-folding) rotor blade
84 Nos. 2-5 rotor blades folded position
85 Rotor head fairing
86 Hydraulic oil reservoir
87 Blade folding hinge joints
88 Rotor head mechanism
89 Cooling air louvres
90 Engine exhaust duct
91 Cabin roof construction
92 Folding step/handhold
93 Tie-down ring
94 Main undercarriage strut mounting
95 Kick-in steps
96 Undercarriage energy-absorbing side strut
98 Starboard navigation light
99 Main undercarriage leg
100 Retraction strut
101 Twin mainwheels
102 Stub wing/walkway
103 Folding step
104 Forward underfloor fuel tanks
105 Cabin air ducting
106 Dipping sonar housing
107 Sonar winch cable drum
108 Winch "pit-head" gear
109 Tape recorder
110 Engine mounting deck
111 Rolls-Royce Gnome H.1400-1 turboshaft engine
112 Engine bay firewall
113 Port engine nacelle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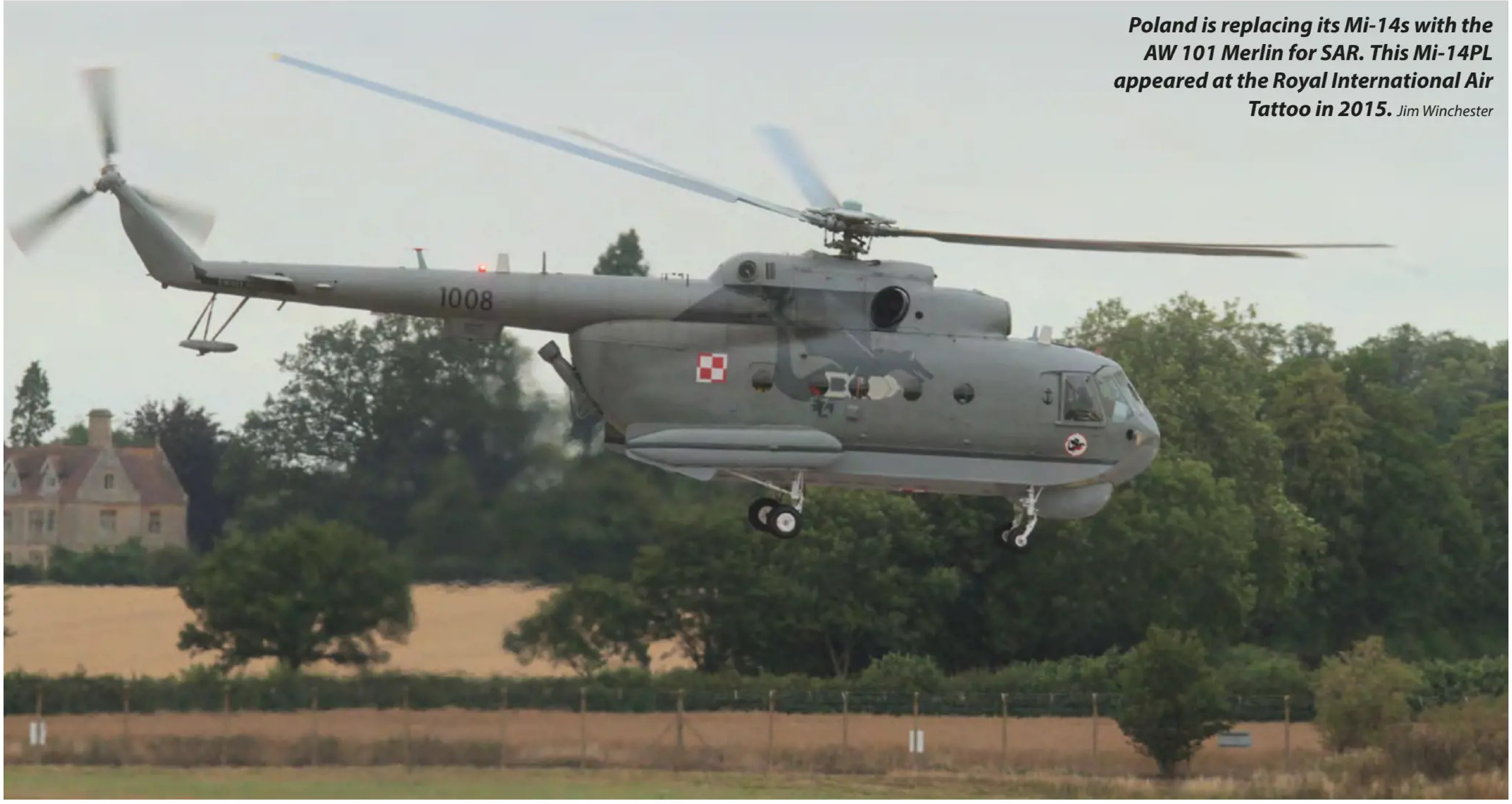
114 Engine oil tank
115 Port engine
116 Engine starter housing
117 Starboard engine air intake
118 Engine mounting strut
119 Intake foreign object deflector
120 Pitot tube
121 Control rod linkages
122 Heating/ventilation system air intake
123 Fuel control computers
124 Cabin heater/blower
125 Boat hull chine longeron
126 Electrical equipment bay
127 Cockpit floor level
128 Fire extinguisher
129 Sliding side window panel
130 Pilot's seat
131 Cockpit bulkhead
132 Radio rack
133 Port entry doorway
134 Rotor brake lever
135 Overhead switch panel
136 Engine control cables
137 Entry door upper segment (open)
138 Pitot tube
139 Cockpit eyebrow windows
140 Windscreen panels
141 Windscreen wipers
142 Air temperature probe
143 Co-pilot's seat
144 Instrument panel shroud
145 Centre control console
146 Cyclic pitch control column
147 Back of instrument panel
148 Yaw control rudder pedals
149 Downward vision window
150 Radio and electronics equipment
151 Anti-collision light
152 Homing aerials
153 Retractable landing/taxying lamps
154 Vertical landing lamps
155 Bow compartment hinged access door
156 Battery compartment
157 Fresh air intakes
158 VHF aerial



Poland is replacing its Mi-14s with the AW 101 Merlin for SAR. This Mi-14PL appeared at the Royal International Air Tattoo in 2015. *Jim Winchester*

Mil Mi-14 'Haze'

Russia's ASW Helicopter

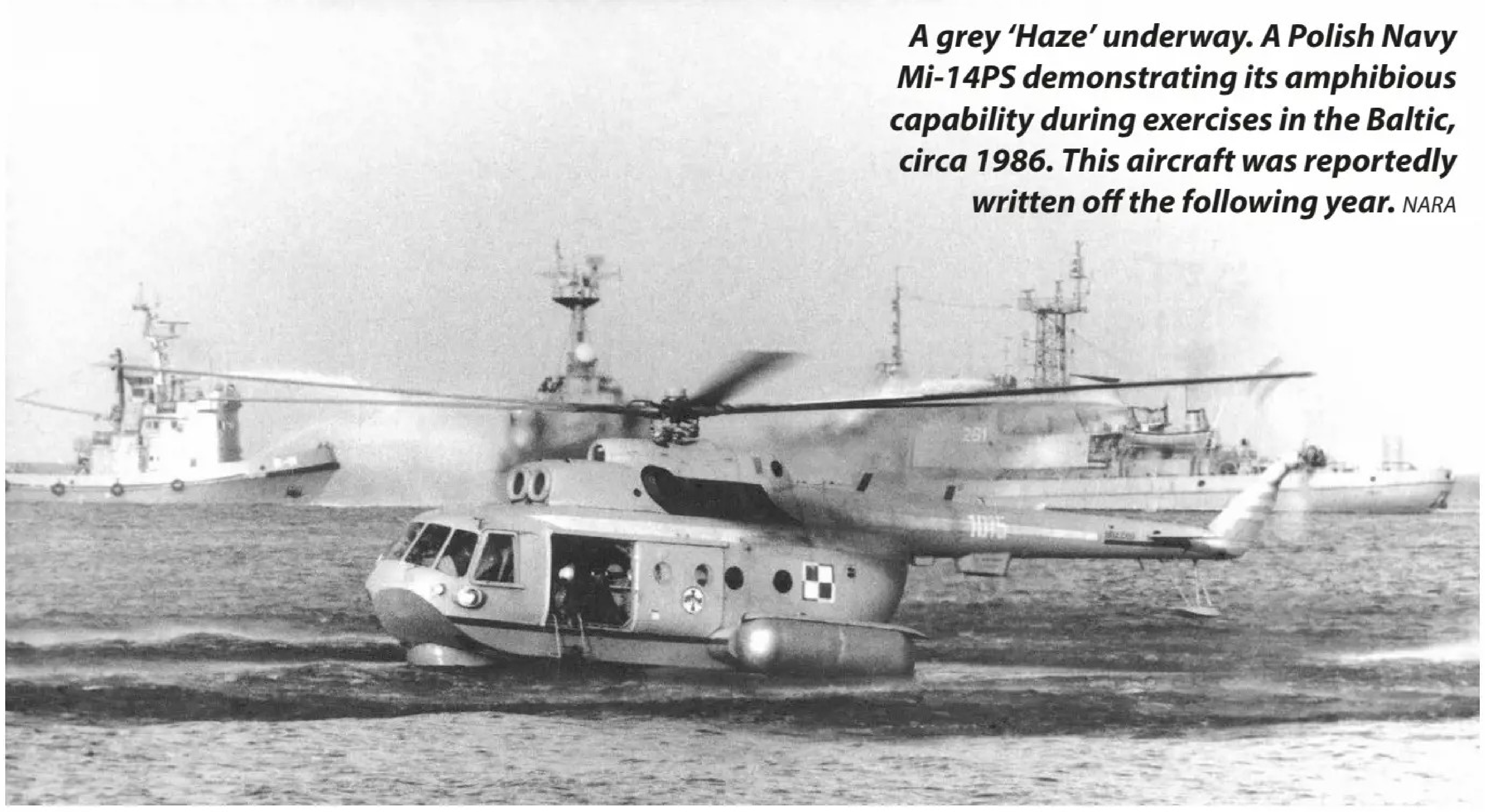
The Mil Mi-14 'Haze' was developed from the Mi-8 as a shore-based amphibious anti-submarine warfare (ASW) helicopter. It was one of the few rotary-wing aircraft able to land on water.

Work on what became the Mi-14 was authorised in April 1965 as the V-8G to replace the Mil Mi-4 'Hound' as a short-range ASW helicopter. It was fitted with a boat-like hull and a retractable, four position landing gear. A water-tight enclosed weapons bay was accommodated in the undersides of the hull, while a retractable radar radome sat under the nose.

The prototype, known as the V-14, completed its maiden flight on 1 August 1967, powered by TV2-117 engines. Problems with the definitive TV3-117MT engines, due to be used by the Mi-14, and development of the helicopter's mission systems, delayed progress. Production only began at Kazan in 1973 and it entered service with Soviet Naval Aviation (Aviatsiya voyenno-morskogo flota, AV-MF) on 11 May 1976. The first ten Mi-14PLs delivered in 1976-77 had less powerful engines and a longer engine cowl than subsequent production examples.

The Mi-14PL was the basic ASW variant, equipped with an OKA-2 retractable sonar, two sonobuoy chutes and APM-60 towed magnetic anomaly detection (MAD) stowed against the rear of the fuselage pod. NATO gave the Mi-14PL the reporting name 'Haze-A' and usually operated from land, as it was too large for most Soviet warships. The Mi-14PL was later upgraded as the Mi-14PLM, announced at the Moscow air show at Zhukovsky in August 1989, in which the MAD 'bird' was relocated lower on the rear fuselage.

A mine countermeasures variant was produced as the Mi-14BT (for Burksirtralschchik – 'towing minesweeper'), known to NATO as the 'Haze-B'. It had an air conditioning pod on the starboard fuselage, plus strakes under the fuselage and dispensed with the MAD. Windows were placed in the lower rear fuselage to observe anti-mine sledge, of which three different types could be towed.



A grey 'Haze' underway. A Polish Navy Mi-14PS demonstrating its amphibious capability during exercises in the Baltic, circa 1986. This aircraft was reportedly written off the following year. *NARA*

A flyby of two Ukrainian Mi-14s at Mykolaiv Air Base during Exercise Sea Breeze in June 2021. It is unclear if any are still operational in Ukraine. US Navy

Tests of the Mi-14BT were undertaken from Feodosia in the Crimea in 1982 and 1983, after which it was deployed on Soviet vessels participating in multi-national mine clearance operations in the early 1980s. Around 25 are believed to have been delivered, but the Mi-14BT's safety performance was poor, with many later being modified for search and rescue (SAR).

The Mi-14PS 'Haze-C' was a dedicated SAR variant developed from the Mi-14BT, carrying up to ten, 20-person liferafts. It also had room for 19 survivors in cabin, plus a rescue hoist and double width doors on port side. Searchlights were mounted either side of the nose and under the tailboom.

Production continued into 1986, with a total of 273 'Hazes' built. Most went to the AV-MF. By 1997 the Russian Navy had just 10 Mi-14PLs – plus 55 Mi-14PSs – in service, with regiments of the Baltic Fleet Aviation Command at Bryusterort; at Kachalovka of the Northern Fleet Aviation Command, and with the Pacific Fleet Aviation Command at Petropavlovsk, which also had an independent squadron at Korsakov. A squadron flying Mi-14s, alongside Mi-8s, at Kacha was assigned to the Black Sea Fleet Aviation Command. By 2010 around 40 Mi-14s remained in service with the Russian Navy.

'Hazes' flew in the colours of around a dozen nations. Cuba had at least four Mi-14PLs, all of which were reportedly sold to North Korea, while other previous operators include Ethiopia (two), Pakistan (two), Georgia (four), Yemen and Yugoslavia (four). Bulgaria flew 10 Mi-14PLs and a pair of 'PS, which had been retired by early 2010. East Germany operated nine Mi-14PLs from October 1979, and six Mi-14BTs from February 1986, all with MHG-18. All but one Mi-14BT survived until German reunification in September 1990, with two later going to the US Army.

Libya received 30 Mi-14PLs from 1982, two of which were converted as Mi-14PZh water bombers. Most were withdrawn during the Libyan Civil War, although at least three gained Free Libyan Air Force markings. Syrian 'Hazes' were operated by 618 Squadron and the helicopters were active during the long Syrian Civil War, but only a handful remained operational in late 2024. The country received 18 Mi-14PLs and two 'PSs.

Ukraine inherited around five Mi-14PL/PSs with the Soviet 555 OPLVP (anti-shipping regiment) at Ochakov upon independence. By the time of the Russian invasion in February 2022, the helicopters were flown by the 456 brTra, but all are understood to have been destroyed by the middle of the year.

Poland flew 'Hazes' from 1981, acquiring 12 Mi-14PLs (operated as Mi-14PŁs) and five 'PS. The OKA-2 was upgraded from 1995, at the end of which the helicopter was able to use western A244S and MU90 torpedoes. One Polish 'Haze' was modified as the Mi-14PX able to undertake search and rescue as well as ASW. A modest avionics upgrade on 10 Mi-14PLs was completed in 2001, followed by a more comprehensive modernisation programme as the Mi-14PLMK, to extend the service life of the fleet by another decade. When the Mi-14PSs ran out of service life they were replaced by Mi-14PLs converted for the SAR role as Mi-14PL/Rs. The fleet was operated by 44.BLotM from Darlowo until the final examples were retired on 31 August 2025, although six Mi-14PL/Rs were due to go to Ukraine. ■

Mil Mi-14PL 'Haze-A'

Crew: Four (four, co-pilot, technician, weapons operator)
Fuselage length: 60ft 4in (18.38m)
Rotor diameter: 69ft 10in (21.29m)
Height: 22ft 9in (6.93m)
Empty weight: 19,620lb (8,900kg)
All-up weight: 30,865lb (14,000kg)
Powerplant: Two Klimov TV3-117 turboshafts, rated at 1,923shp (1,434kW) each
Max speed: 143mph (230km/h)
Range: 705 miles (1,185km)
Service ceiling: 11,500ft (3,500m)
Armament: One AT-1 or APR-2 torpedo, or one 'Skat' nuclear depth charge, or eight PLAB-250, PLAB-50-64 or PLAB-MK depth charges

An RN Lynx HAS.1 approaches HMS* Birmingham *as a Dutch H-14 observes. The two aircraft were both assigned to the bi-national No. 700L Squadron in 1977

Westland Lynx and Leonardo Wildcat

Big Cats at Sea

The Lynx family has operated at sea for nearly half a century with the Royal Navy, as well as serving from the warships of a dozen other nations. Although many countries have retired their first-generation aircraft, the later Super Lynx and the current Wildcat are still flown by navies across the globe.

Along with the Sud Puma and Gazelle, the Westland Lynx was included in the February 1967 Anglo-French helicopter agreement to reinvigorate the rotary-wing fleets of both nations' armed forces. Variants suitable for both battlefield and naval operations were to be developed for Great Britain and France. The prototype WG.13 flew on 21 March 1971 at Yeovil, Somerset, in the hands of Chief Test Pilot Wilfred Ronald 'Ron' Gellatly, along with Test Pilot Leonard Roy Moxam. G-BEAD/XW385 was one of a batch of 12 pre-production examples.

Priority went to developing the army versions, with a landing skid, while the naval variant had a wheeled landing gear, as well as a deck restraint system, folding main rotor blades, an emergency flotation system and nose-mounted radar. The first Lynx HAS.2 flew on 10 February 1976 and in September that year No. 700L Squadron formed at RNAS Yeovilton, Somerset, as the Lynx Intensive Flying Trials Unit, in preparation for the type entering frontline with the Royal Navy and Royal Netherlands Navy. Its work was completed at the end of 1977 and formed the core of No.702 Squadron, established on 3 January 1978 as the Lynx headquarters and training unit. At the start of 1981 the headquarters role and the small ship's flights were transferred to the newly reformed 815 Squadron at RNAS Yeovilton.

A total of 60 Lynx HAS.2s was built. The helicopter first saw action in the 1982 Falklands War, protecting the British task force from Argentine submarines. On 3 May a Lynx fired a Sea Skua anti-shipping missile at the ARA Alférez Sobral, severely damaging the patrol boat. Three Lynxes were destroyed during the campaign, all by Argentine bomb or missile hits of HMS *Ardent,* HMS *Coventry* and the SS *Atlantic Conveyor*. During July 1982 both 702 and 815 Squadrons relocated to RNAS Portland, Dorset.

In the early 1980s the first of an eventual 30 new-built Lynx HAS.3s were acquired, while all 53 surviving HAS.2s were upgraded. The changes included more powerful Gem 42-1 Mk 204 engines and an uprated transmission, a new floatation system and Orange Crop electronic support measures (ESM). From September 1986 the Westland Wasp-equipped No.829 Squadron began to receive some Lynxes and had completed re-equipping with the helicopter in 1988.

Torpedo-armed Lynx HAS2(FN) flying from guided missile frigate La Motte-Picquet. *Jim Winchester collection*

Over the years various subtypes of the Mk 3 evolved. They included the HAS.3(ICE), configured to operate in polar conditions from HMS Endurance; the HAS.3GM, modified for operations in the Arabian Gulf; HAS.3S, SGM and S(ICE) for those equipped with secure radios; and the HAS.3CTS (Central Tactical System) with the RAMS 4000 CTS, an improved Orange Crop ESM, BERP blades and revised tail rotor.

Ten Royal Navy Lynx HAS.3s were deployed during the 1991 Gulf War, augmenting those with already with the Armilia Patrol in the region on the day Iraq invaded Kuwait. During the war they were used to occupy oil platforms and spot Iraqi warships. Lynxes from HMS *Cardiff* and HMS *Gloucester* participated in the Battle of Bubiyan, firing 15 Sea Skuas that sank 14 Iraqi Navy vessels.

The seven Lynx HAS.3CTSs served as avionics testbeds for the HAS.8, undergoing evaluation with the Operational Flight Trials Unit at RNAS Portland. A GEC Sensors Sea Owl forward looking infrared was mounted on the nose, with the Seaspray radar relocated under it, while take-off weight was increased. The HAS.8 designation was replaced by HMA.8 by the time a reformed 700L had completed tests with the variant. The Lynx HMA.8 entered service in 1992, and an initial 10 HAS.3Ss were upgraded to the new standard. In March 1993 No. 829 Squadron disbanded and its operations merged with No. 815 Squadron. During March 1999 RNAS Portland closed, with the Lynx fleet relocating to RNAS Yeovilton.

Although the naval Lynx was due to be replaced by the EHI Merlin HM.1, cuts to the number to be procured resulted in the decision being taken to upgrade another 28 Lynxes as HMA.8s. Upgrades included the addition of a digital signals processor (DSP, (creating the short-term HMA.8DSP designation, until all had been retrofitted), while around a dozen had defensive aids subsystems added as HMA.8DASs. Later, the fleet was equipped with the SATURN secure radio to become HMA.8SRUs. Many of the upgrades incorporated in the HMA.8 were also offered to the many export customers as the Super Lynx.

Apart from some pre-production aircraft delivered to France, the Netherlands became the first export customer to receive Lynxes, accepting six Mk 25s as UH-14As, ten Mk 27s as SH-14Bs and eight Mk 81s as SH-14Cs, the later equipped with magnetic anomaly detection (MAD) gear for ASW. Dutch navy crews trained at RNAS Yeovilton between December 1976 and May 1977 with 700L Squadron, before being transferred to Vliegtuigsquadron (VGSQ) 7. The SH-14Bs and 'Cs entered service with VGSQ 860, which deployed the helicopters at sea. All Dutch Lynxes were shore-based at De Kooy.

Later the MADs were removed from the SH-14Cs, which became 'Bs, as part of the Standardisation and Modification Lynx programme. All 22 survivors were upgraded to the new SH-14D configuration with uprated Gem engines by 1997, while ten underwent a service life extension due to delays of the arrival of the replacement NHIndustries NH90 NFHs. The Netherland Naval Air Service performed its last operational Lynx flight on 19 September 2012.

From January 1979 nine Lynx Mk 21s were delivered to the Brazilian Navy, entering service with HA-1 as SAH-11s. Nine replacement Mk 21As were delivered between September 1996 and

Danish Air Force Lynx 90B S-191 takes off from the Norwegian frigate* Helge Ingstad *in 2014. The Lynx was retired and the frigate sank in 2018. **Nato Marcom**

August 1997, while five surviving Mk 21s were upgraded to the new standard, all becoming AH-11As. They primarily served from 'Niterói'- and 'Greenhalgh'-class frigates, 'Inhaúma'-class corvettes and the destroyer *Pará*.

France acquired 26 Lynx HAS.2(FN)s fitted with a French radar and the ability to fire AS.12 missiles. The first flew on 24 October 1979 and the fleet was later augmented by 14 Lynx HAS.4s, serving with 31F based at Hyères and 34F at Landévoc-Poulmic, while 10S performed crew training at Hyères. Planning to replace the Lynx with the NH90 NFH started in 2008, but the helicopter remained in service for a dozen more years, performing its last operational deployment at sea in July 2020. The Lynx was formally retired by the French Navy on 4 September that year.

Frogmen jump from a Brazilian AH-11A Super Lynx in 2015. This aircraft was later upgraded to Mk. 21B Wild Lynx standard. *Marinha do Brasil*

Eight Lynx Mk 80s were delivered to Denmark from June 1980, while two Mk 90s were received in 1987 as attrition replacements, sourced from airframes of an embargoed Argentinean order. Only one Mk 23 had been delivered to Argentina, but the 1982 Falkland War ended the supply of spares and it eventually went to Denmark as a source of spares. All Danish Lynxes were upgraded as Mk 80A/90As between 1991 and 1994, but eight new Super Lynx Mk 90Bs were ordered in 1997, into which the systems of the existing fleet were installed. The Mk 90Bs entered service between November 2000 and February 2008. The Lynx was replaced by the Sikorsky MH-60R Seahawk, with the last three performing a farewell flight at Karup on 17 December 2017.

From September 1981 the West German Navy received 19 Lynx Mk 88s for Marinefliegergeschwader 3 at Nordholz. Delays to the NH90 programme resulted in seven Lynx Mk 88As being ordered in October 1996, which were delivered in 1999 and 2000. In addition, new airframes were acquired for the 15 surviving Mk 88s, which were upgraded as 88As with uprated Gems and new systems. German Lynxes participated in several United Nations missions and were deployed on counter-piracy missions off the Somalian coast from 2012. The fleet is expected to be replaced by NH90 Sea Lions by the end of 2026.

Norway operated six Lynx Mk 86s, which became operational on 1 May 1983 with 337 Squadron, although they were flown on behalf of the coast guard. As such they remained unarmed and regularly operated from the 'Nordkapp'-class

A Lynx HAS.3SGM passes behind an HMA.8 at Yeovilton in 2009. The latter was fitted with an M3M 0.50in machine-gun. *Jim Winchester*

A 815 NAS Wildcat drops a Training Variant Torpedo during Exercise Tamber Shield in Norway as part of the work-up to the 2025 High Mast deployment of HMS* Prince of Wales *to the Far East. *LPhot Unaisi Luke/Crown Copyright*

ocean patrol vessels, as well as the icebreaker KV *Svalbard*. One was damaged in an accident on 12 January 1988, but was rebuilt using a new airframe. Although deliveries of NH90s began in 2005, Norway's Lynxes remained in service until the end of 2014.

Nigeria had three Lynx Mk 89s from 1984, but they were out of service by the early 2000s due to a lack of spares. Three former Royal Navy Lynx HAS.3s were sold to Pakistan for operation from its 'Amazon'-class frigates, joining 222 Squadron of the Pakistan Navy from August 2004. They were withdrawn by 2008.

Portugal bought five Lynx Mk 95s, two of which had previously served with the Royal Navy as HAS.3Ss. All were handed over in 1994. They were upgraded as Mk 95As between 2020 and July 2021 with improved engines and avionics to extend service life into the mid-2030s.

The Korean Navy was the first to order the Super Lynx. Twelve Mk 99s were acquired for 627 Squadron at Jinhae, with the first delivered to Korea in December 1990 after crew training at Yeovil. A further 13 Mk 99As were ordered and handed over from September 1999 for 629 Squadron. The fleet was later upgraded by KAI to a similar standard as the Super Lynx 300. After a pair of Lynxes crashed with a week in 2010, it was discovered the fleet had been subject to a scam involving faked replacement components. Korea announced it had selected the Wildcat in January 2013, with a requirement for eight. They were delivered in batches of four in June and November 2016.

An order for four Super Lynx 300s was signed by South Africa on 14 August 2003, with crew training under way in early 2007. The helicopters, Super Lynx Mk 64s, arrived in South Africa in July 2007 and were deployed on 'Valour'-class frigates as an airborne sensor platform, weapons initially being limited to door mounted machine guns.

The Royal Malaysian Navy replaced its Wasps with six Super Lynx Mk 100s, most of which were delivered in 2003, while the Algerian Navy acquired four Super Lynx 300s. During 2004 a pair of Super Lynx 300s was delivered to the Royal Thai Navy, entering service with 203 Squadron.

In 1996 GKN took over Westland, which became GKN Westland Helicopters two years later. On 29 January 2002 it received a Ministry of Defence contract to investigate the Future Lynx for the Army's Battlefield Light Utility Helicopter (BLUH). Around the same time the Admiralty expressed a need for 55 to 60 Surface Combatant Maritime Rotorcraft (SCMR) to replace the Lynx HAS.3s and HMA.8s. It was announced on 24 March 2005 that BLUH and SCMR would be meet by Future Lynx, with an order for around 90. Future Lynx would use the dynamic systems of the Super Lynx 300, with a redesigned aft fuselage and tail rotor, new systems and avionics, including a 'glass cockpit'. It had been renamed the Lynx Wildcat by the time the prototype flew from Yeovil on 12 November 2009; by then the company had become AgustaWestland.

A total of 28 Wildcat HMA.2s were acquired for the Royal Navy, with initial examples going to 700W Squadron, the Wildcat Fielding Squadron, at RNAS Yeovilton in 2009. During February 2011 a prototype spent 20 days onboard HMS Iron Duke, while the first production standard example was handed over in late 2013.

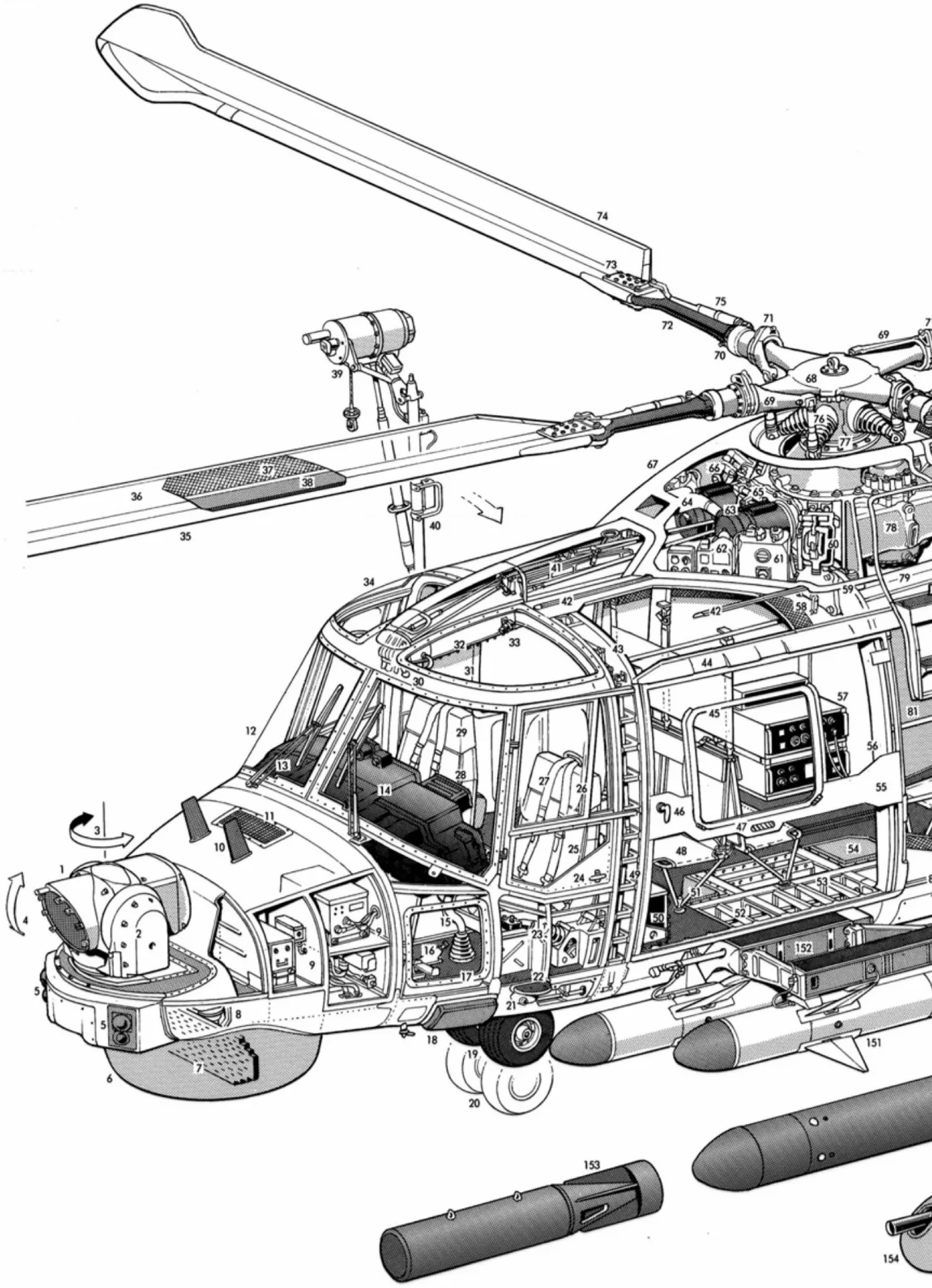
On 10 October 2014 Nos 700W and 702 Squadrons merged to form 825 Squadron. It completed the initial operational deployment at sea by the Wildcat, between March and December 2015 on HMS *Lancaster*. By then the Lynx fleet has started to be retired, with the last leaving service in March 2017. No.815 Squadron had begun receiving Wildcats in April 2016 and would comprise a headquarters flight and around 15 flights, allowing 825 to concentrate as training crews for the type. As of late 2025, the Wildcat HMA.2 fleet is shared by the two squadrons, providing anti-shipping and anti-submarine roles from the Royal Navy's surface fleet, as well as undertaking airborne surveillance.

Exports of the Wildcat have been limited to South Korea and the Philippines. The latter nation acquired two to operate from its Jose Rizal-class frigates. They arrived in country in May 2019. ■

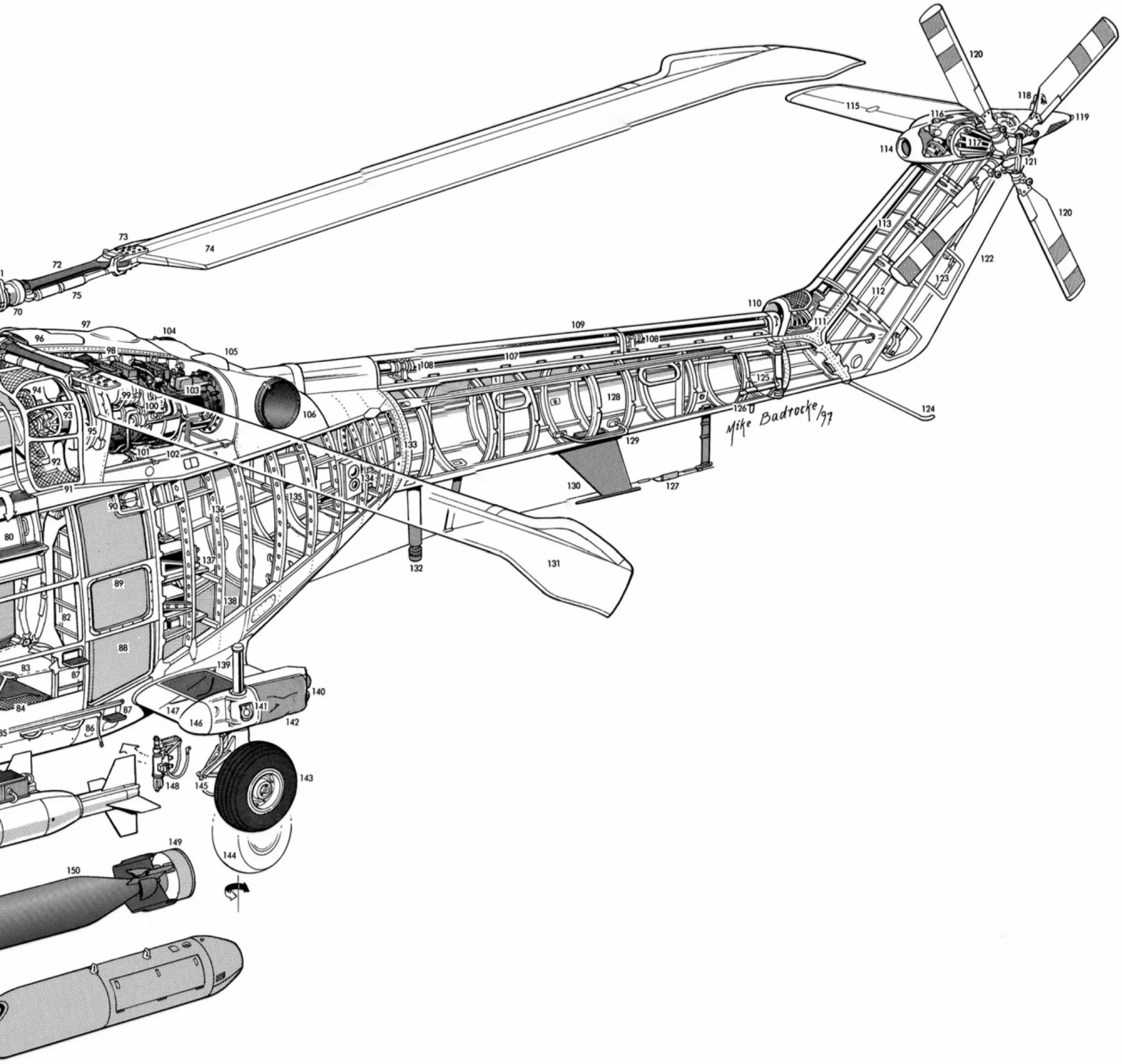
Westland Lynx HAS.3

Crew: Two or three (pilot and observer/navigator, and weapons systems operator in cabin)
Fuselage length: 39ft 1in (11.92m)
Rotor diameter: 42ft 0in (12.80m)
Height: 11ft 10in (3.60m)
Empty weight: 6,040lb (2,740kg)
All-up weight: 10,500lb (4,763kg)
Powerplant: Two Rolls-Royce Gem 42 Mk 204 turboshafts, rated at 1,120shp (835kW) each
Max speed: 144 mph (232km/h)
Range: 368 miles (593km)
Service ceiling: 10,600ft (3,230m)
Armament: Two Mk 44, 46 or Sting Ray torpedoes, or up to four BAe Sea Skua anti-shipping missiles, or two Mk 11 depth charges; optional door-mounted machine gun

Westland Lynx HMA.8



1 GEC-Marconi Avionics ‘Sea Owl’ thermal imager
2 Gimballed turret assembly
3 Azimuth range 120 degrees either side
4 Elevation range 20 degrees up and down
5 Racal MIR-2 ‘Orange Crop’ passive radar detection antennas
6 Ventral radome
7 GEC-Marconi Avionics ARI5979 Seaspray Mk. 1 radar scanner
8 Scanner drive, 360-deg coverage
9 Avionics equipment bay (radar) access port and starboard
10 UHF homing antennas
11 Ventilating air intake
12 Electrically heated windscreen panels
13 Windscreen wipers
14 Shrouded instrument panel
15. Co-pilot/observer’s cyclic pitch control column
16 Adjustable rudder pedals
17 Downward vision window
18 Forward flotation bag
19 Fixed castoring twin-wheel Mose undercarriage
20 Nosewheel rebound position
21 Port navigation light
22 Boarding step
23 Collective pitch lever
24 Jettisonable cockpit door, port and starboard
25 Co-pilot/observer’s seat
26 Direct vision sliding side window panel
27 Safety harness
28 Shrouded radar display
29 Pilot’s seat
30 Engine power and condition levers
31 Starboard sliding cabin door
32 Overhead switch panel
33 Instrument panel light
34 Cockpit roof glazing
35 Main rotor blade leading-edge titanium erosion sheath
36 Glass-fibre reinforced plastic (GFRP) trailing-edge skin
37 Honeycomb composite core
38 GFRP blade spar
39 Rescue hoist/winch, 600lb (272kg) capacity
40 Hoist pintle mounting, starboard cabin doorway
41 Engine control ducting
42 Sliding cowling rails
43 Forward fuselage arch double main frame
44 Sliding cabin door top rail fairing
45 Jettisonable window panel
46 Door latch
47 Window jettison handle
48 Lightweight demountable cabin seats
49 Flight control rod linkages
50 ESM pulse receiver
51 Forward underfloor fuel cells, total useable capacity 210 imp gal (957 litre)
52 Cabin floor frame structure
53 Fuselage keel web
54 Fuel collector tanks (two)
55 Port rearward sliding cabin door
56 Forward gearbox mounting main arch frame
57 Cabin mission avionics equipment rack
58 GFRP/honeycomb cabin roof panel
59 Forward gearbox mounting
60 Lateral control autostabilised servo-actuator
61 Hydraulic reservoir, dual system
62 Hydraulic equipment module, port and starboard
63 Dual alternators
64 Alternator cooling air intake and ducting
65 Collective pitch servo-actuator
66 Longitudinal pitch control autistabiflised servo-actuator
67 Forward-sliding equipment bay cowling
68 Hingeless main rotor hub, titanium
69 Blade pitch control horns
70 Pitch bearings
71 Individual bearing oil reservoirs
72 Flexible blade arm
73 Blade root attachment joint, manually foldable
74 Four-bladed main rotor
75 Dear hinge dampers
76 Blade pitch control rods
77 Mian rotor mast
78 Main gearbox
79 Gearbox mounting deck
80 Fold-down work platform and step
81 Starboard main fuel cell
82 Fuel bay bulkhead
83 Lightweight folding seat
84 GFRP/honeycomb forward fuselage skin panels
85 Sliding cabin door lower rail
86 Torpedo parachute lanyard attachment
87 Fold-out maintenance access steps
88 Port main fuel sell
89 Fuel cell access panel
90 Gravity fuel filler, pressure refuelling connector on starboard side of rear fuselage
91 Engine intake with protective grille
92 Aft gearbox mounting
93 Engine-to-gearbox drive with flexible coupling
94 Rotor brake on tail rotor output shaft
95 Engine compressor intake
96 Starter/generator intake/exhaust fairing
97 Starboard engine cowling/downward hingeing work platform
98 Engine bay dividing titanium fireproof bulkhead
99 Starter/generator
100 Accessory equipment gearbox
101 Forward main engine mounting
102 Titanium fireproof mounting deck
103 Rolls-Royce Gem 42-1 turboshaft engine
104 Starboard engine exhaust
105 Ventilating air exhaust duct
106 Port engine exhaust nozzle
107 Tail rotor transmission shaft
108 Shaft bearings
109 Hinged shaft access fairing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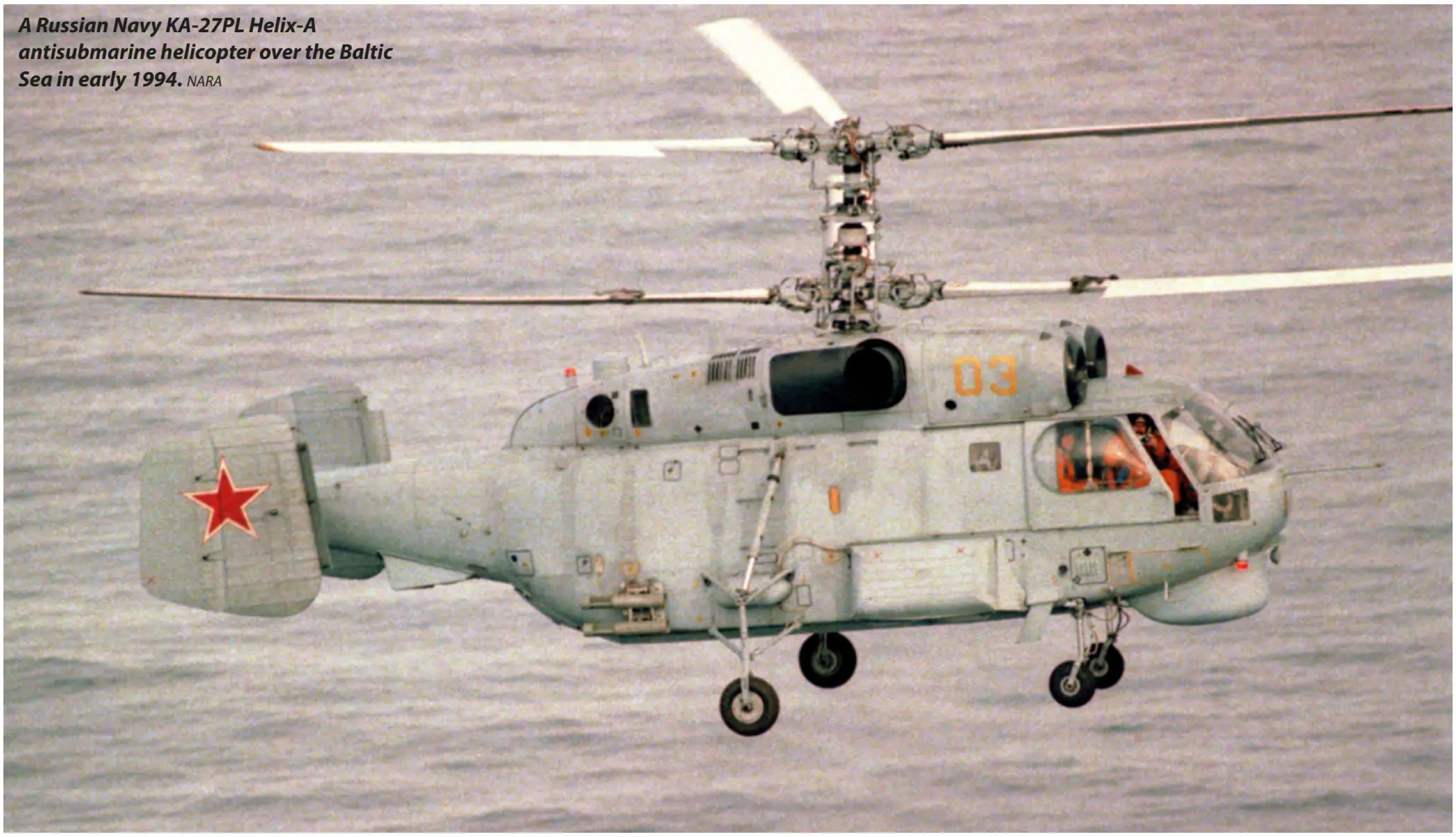
110 Cooling air intake
111 Intermediate gearbox
112 Tail pylon structure
113 Final drive shaft
114 Gearbox cooling air intake
115 Fixed horizontal tailplane
116 Tail rotor power control
117 Final drive right-angle gearbox
118 Anti-collision beacon
119 Tail navigation light
120 Four-bladed CFRP composite tail rotor
121 Blade pitch control linkage
122 CFRP tail fairing access panel
123 Tail rotor control rods
124 Tailskid/rotor protector
125 Folding rail latch mechanism, tail folds to starboard
126 IFF antenna
127 HF antenna
128 Tailboom frame structure
129 VOR antenna
130 V/UHF antenna
131 BERP advanced design swept main rotor blade tip
132 I-band antenna
133 Tailcone joint frame
134 Lateral 'Orange Crop' passive radar detection antennas
135 Rear avionics equipment shelf
136 Rear fuselage conventional light alloy frame structure
137 Main avionics equipment racks, communications system
138 Ventral access hatch
139 Mainwheel shock absorber strut
140 Aft 'Orange Crop' antenna fairing
141 Tie-down shackle
142 Aft flotation bag
143 Port mainwheel
144 Mainwheel rebound position and castoring angle
145 Torque scissor links
146 Port mainwheeel sponson
147 Ventral Doppler antenna fairing
148 Ventral hydraulic deck-lock 'Harpoon'
149 Torpedo parachute housing
150 Sting Ray lightweight homing torpedo
151 Sea Skua anti-ship missiles
152 Weapons pylons, single or dual weapons fit
153 Mk. 11 depth charge
154 FN HMP 0.5in calibre self-defence machine-gun



A Russian Navy KA-27PL Helix-A antisubmarine helicopter over the Baltic Sea in early 1994. NARA

Kamov Ka-27 'Helix' Family

Co-Axial Multitasker

The successor to the Ka-25 followed the same basic layout as the 'Hormone' and spawned several variants for ASW, AEW, assault and a number of civilian roles.

Development of a more capable ASW helicopter for the Soviet Navy began in 1969 and test pilot Yevgeniy I Laryushin conducted the first hovering flight of a prototype initially known as the Ka-252 on 8 August 1973. This was actually a few weeks before the commander of the Soviet Navy endorsed the report of the mock-up commission, which recommended that development proceed. Unsurprisingly there were some changes made between the prototype and subsequent aircraft, such as a reprofiled nose, which the commission ordered to improve cockpit visibility. Flight testing showed problems with hover stablisation and the the automatic flight control system that allowed the helicopter to fly a pre-planned sequence of sonar dips and dashes. The sliding doors did not seal, allowing freezing air into the cockpit.

When acceptance trials were finally completed in late 1978, the Ka-252 was ordered into production as the Ka-27, named 'Helix-A' by Nato. The basic ASW version was commissioned into Soviet Naval Aviation (AV-MF) service in April 1981. It could operate in a screen up to 124 miles (200km) from its mother ship. A datalink allowed the tactical picture to be shared between ships and helicopters. The early Ka-27 was powered by two TV3-117V engines rated at 2,190shp (1,635 kW), giving twice the power of the Ka-25 for about 25 per cent extra empty weight. Most of this cane from a new boxy fuselage

The Ka-27's main sensor was the Osminog (Octopus) search radar in an undernose radome. The crew was usually three, consisting of a pilot, a navigator and a sensor operator.

Additional fuel tanks could be scabbed onto the fuselage sides. Inflatable flotation bags were also often mounted on the undercarriage.

As many as 90 Ka-27s are still in Russian Navy (AV-MF) service and another six with the Russian Air Force. Export aircraft were designated Ka-28 ('Helix-D'). China's naval air force (PLANAF) received at least six from 1999 and they serve on Type 052C and 052D destroyers, although some sources say that only one remains in service. The Syrian Navy is believed to have operated four or five Ka-28s of which at least one was still in airworthy condition in 2025.

An assault variant capable of carrying 29 troops, the Ka-29TB ('Helix-B'), entered service in 1984. It had a new, wider fuselage allowing room for a gunner between the pilot and navigator. A 7.62mm machine-gun was fitted in the lower left side of the nose. Stub wings could carry rocket pods, guns or anti-tank missiles. Nato designated the Ka-29TB the 'Helix-B'. Although development was stalled by the collapse of the Soviet Union, about 20 were eventually completed, with ten in service today with the AV-MF. Another somehow found its way to the air force of Equatorial Guinea.

Ukraine inherited 18 Ka-27s and Ka-29s with the fall of the Soviet Union. About four Ka-27s are still in Ukrainian Navy service. Vietnam received at least eight Ka-28s in 1986-1990, some of which were noted in service as recently as 2023. The Yugoslav Navy had two Ka-28s and these remained in service with Serbia until 2003 before going on museum display.

The Ka-31 is a dedicated airborne early warning (AEW) variant. Work started in

An Indian Navy Kamov Ka-31 helicopter landing on the 'Ticonderoga-class' cruiser USS Bunker Hill during the Malabar 2012 exercise. *Chief Petty Officer John Grandin, US Navy*

1985 and a prototype based on the Ka-29 airframe flew in 1987. It is distinguished by its E-801 Oko radar, which has a large flat-plate rectangular antenna on a hinged mounting under the fuselage. To provide a clear field of view when the radar is extended, a retractable undercarriage was fitted. The end of the Cold War saw the project proceed at a very slow pace, but interest from India helped keep it alive and four, later increased to 14, Ka-31s were ordered for the Indian Navy in 1999. China purchased nine in 2010 and Russia itself eventually adopted the Ka-31R, but to date only three are known to have entered service.

A shipboard version for polar research, the Ka-32S 'Helix-C' flew in 1980 and entered production in 1986. Azerbaijan has four in its air force, Algeria has three, Vietnam, two, South Korea seven and Laos, two. Three were supplied to Yemen and an unknown number to Cuba.

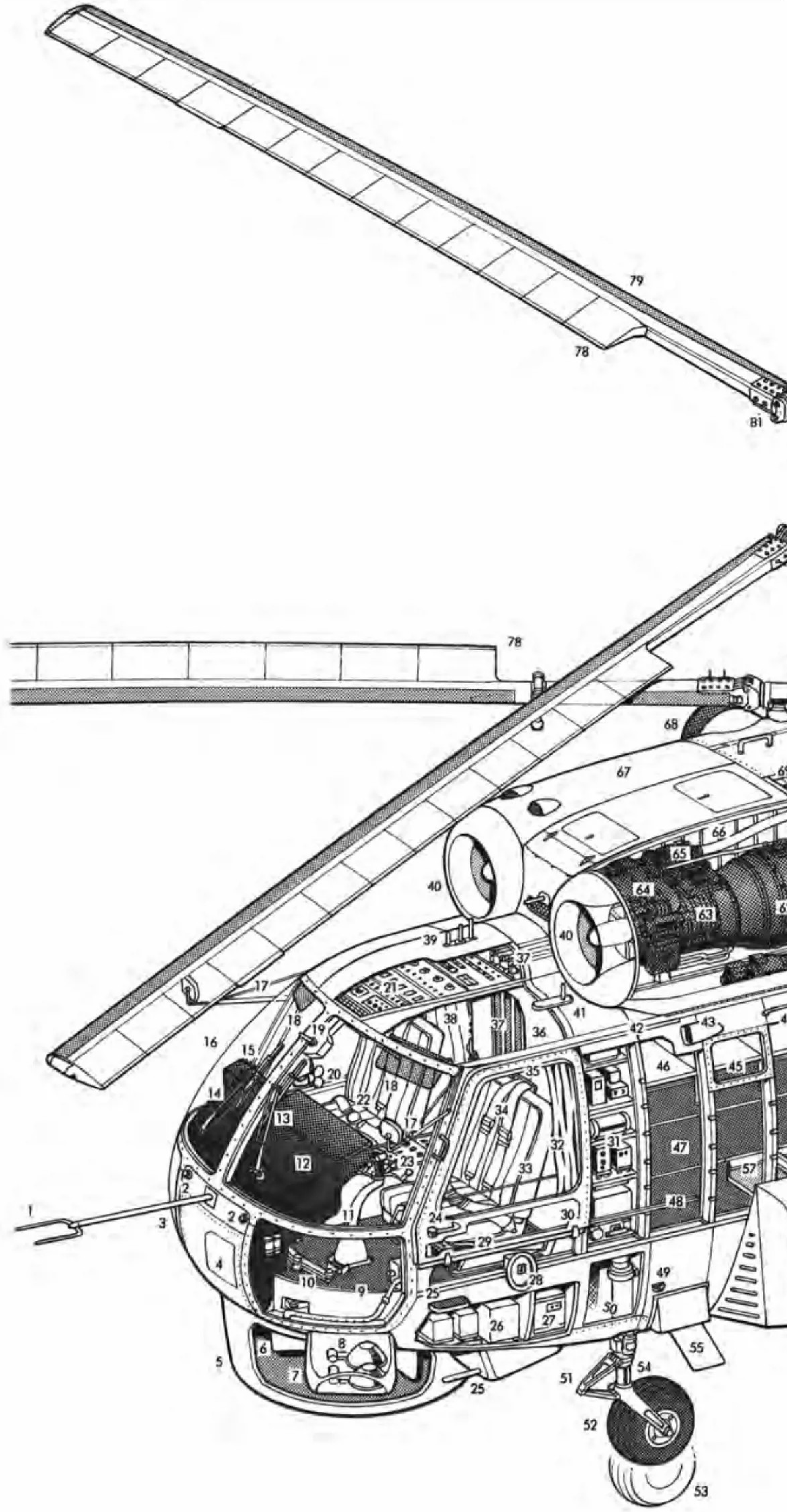
Kamov (now part of the Russian Helicopters contortion) found success with the Ka-32T on the civil market, being particularly suitable for long-line operations such as logging and fire-fighting. More than 240 have been built and exported around the world. A single Ka-32T was operated by the US Army as an opposition force (Opfor) adversary aircraft from 1995. ■

A Ukrainian Navy Ka-27 takes off from the 'Blue Ridge'-class command and control ship USS* Mount Whitney *in the Black Sea during exercise Sea Breeze 2018. *US Navy*

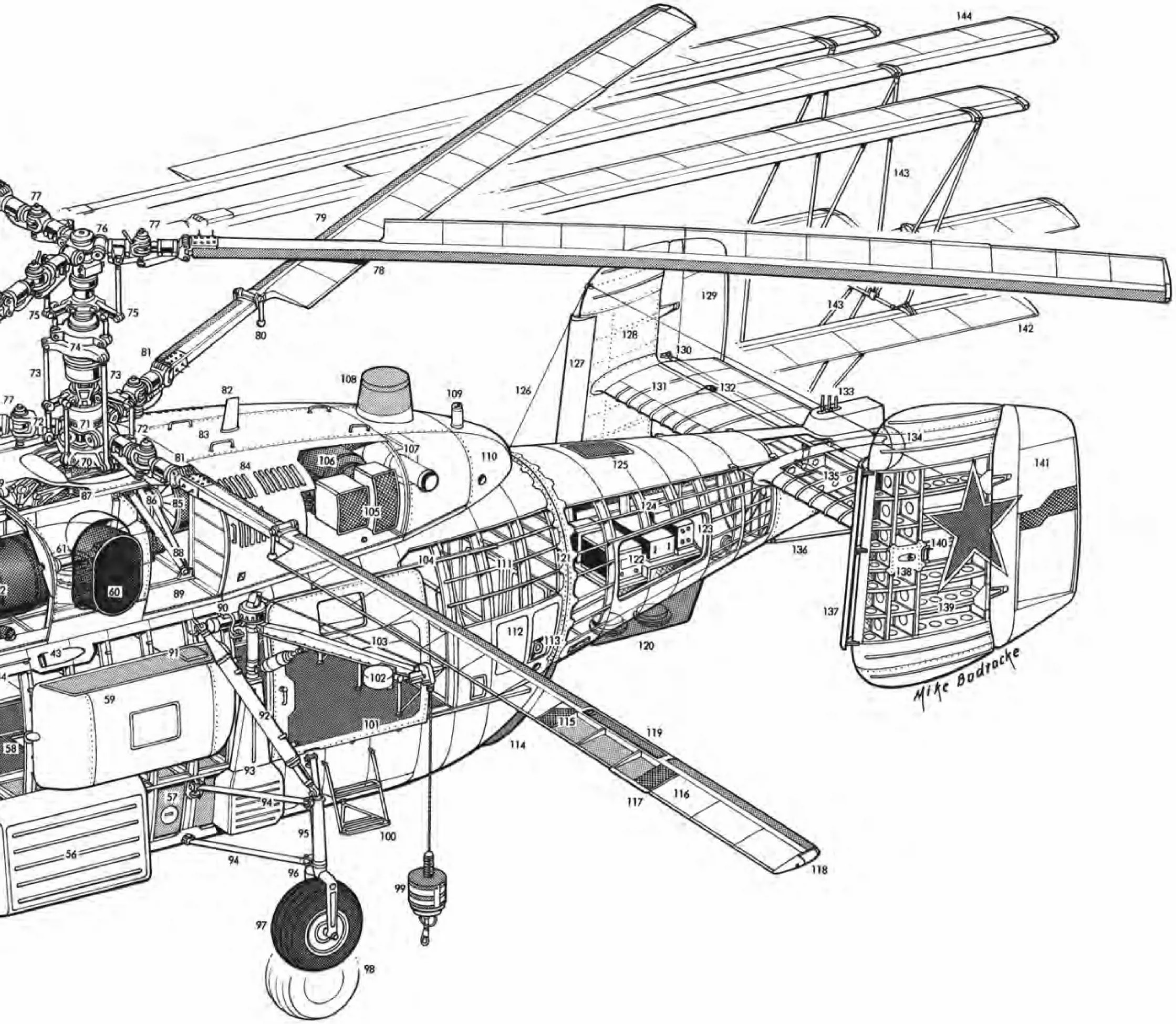
Kamov Ka-27PS 'Helix'

Crew: Two or three
Fuselage length: 40ft 3in (11.30m)
Rotor diameter: 52ft 2in (15.90m)
Height: 17ft 9in (5.40m)
Empty weight: 25,510lb (11,570kg)
All-up weight: 26,450lb (12,000kg)
Powerplants: Two Klimov TV3-117VK turboshafts, each rated at 2,225shp (1,659kW)
Max speed: 168mph (270km/h)
Range: 472 miles (760km)
Service ceiling: 16,405ft (5,000m)
Armament: Payload up to 1,000kg
One AT-1MV ASW torpedo or APR-2 ASW missile

Kamov Ka-27 Helix



1 Air data sensor probe
2 Forward radar warning antennas
3 Downward vision window
4 Instrumentation access panel
5 Ventral radome
6 360-degree rotating search radar scanner (Ka-27 Helix-A and Ka-32S Helix-C)
7 Lateral lamp housing
8 Twin remotely controlled floodlights
9 Cockpit floor level
10 Yaw control rudder pedals
11 Cyclic pitch control column
12 Instrument panel shroud
13 Windscreen wipers
14 Radar display
15 Radar control panel
16 Curved windscreen panels
17 Rearview mirror port and starboard (Ka-27 Helix-A and Ka-32S Helix-C)
18 Retractable sun visors
19 Air temperature probe
20 Cockpit air circulation fan
21 Overhead switch panel
22 Navigator's swivelling seat
23 Engine power and condition levers
24 Sliding door latch
25 Boarding steps
26 Electrical equipment bay
27 Battery
28 Ground power socket
29 Collective pitch control lever
30 Sliding cockpit door (port and starboard)
31 Avionics equipment racks
32 Folding sun blind
33 Pilot's seat
34 Safety harness
35 Bulged side observation window
36 Cockpit rear bulkhead
37 Control rod runs
38 Starboard side observer/loadmaster/winch operator's seat
39 Forward Odd-rods IFF aerials
40 Engine air intakes, bleed air de-icing
41 Intake air temperature sensor
42 Sliding cockpit door top rail
43 Cabin fresh air ventilating intakes
44 Handgrip
45 Cabin window panel
46 Cabin wall-mounted passenger seating (16 passengers in Ka-32T)
47 Main cabin loading floor
48 Sliding door lower rail
49 Tie-down point
50 Nose undercarriage leg strut
51 Torque scissor links
52 Self-centering castoring nose wheel
53 Nosewheel rebound position
54 Shock absorber strut
55 Position of communications aerial on starboard side
56 Flotation gear pannier, port and starboard (Ka-27 and Ka-32S)
57 Underfloor fuel tank groups, port and starboard
58 Floor hatch for externally slung load (maximum 11,000lb/5,000kg)
59 External long-range fuel tank
60 Lateral engine exhaust port
61 Engine/gearbox coupling shaft
62 Engine turbine section
63 Isotope TV3-117V turboshaft engine
64 Engine accessory equipment gearbox
65 Generator
66 Engine bay fireproof bulkhead
67 Hinged engine cowling/work platform
68 Starboard engine exhaust duct
69 Rotor head hydraulic actuators
70 Lower rotor swashplate mechanism
71 Articulated rotor hub
72 Blade pitch control rods
73 Upper/lower rotor interconnecting control rods
74 Upper rotor swashplate mechanism
75 Blade pitch control links and rods
76 Upper rotor articulated hub
77 Blade folding hinge joints, manual folding
78 Three-bladed, co-axial, contra-rotating main rotors
79 Electric thermal leading-edge de-icing
80 Vibration damping pendulum weights, lower rotor only
81 Blade root attachment fittings
82 Communications aerial
83 Maintenance handgrips
84 Cooling air louvres
85 Oil cooler fan
86 Rotor brake
87 Central combining and main reduction gearbox
88 Gearbox mounting struts
89 Engine and gearbox mounting deck
90 Rescue hoist/winch hydraulic motor and gearbox
91 Pannier tank filler cap
92 Main undercarriage shock absorber strut
93 Rescue hoist/winch mounting
94 Main undercarriage wishbone links
95 Mainwheel leg strut
96 Mainwheel forks
97 Port mainwheel
98 Mainwheel rebound position
99 Rescue hoist/winch (Ka-27 and Ka-32S), 660lb (300kg) capacity
100 Boarding steps
101 Main cabin sliding door
102 Hoist floodlight
103 Three-abreast rear seat row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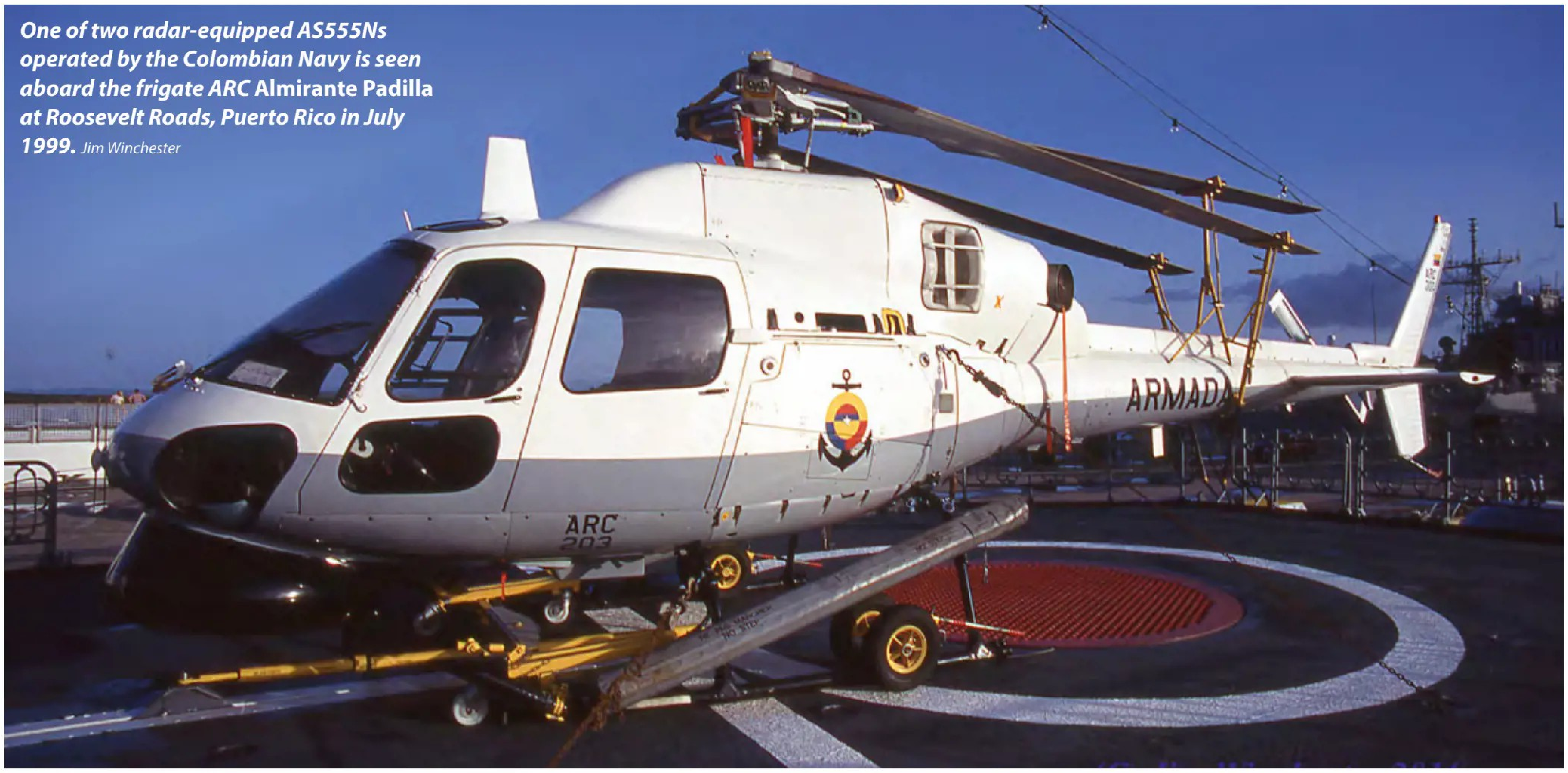
Mike Badrocke

104 Sliding door rail
105 Air intake grilles
106 Airborne auxiliary power unit (APU_
107 Cabin heater unit
108 ESM antenna (Ka-27)
109 Upper anti-collision light
110 Engine/gearbox/APU tail fairing
111 Fuselage frame and stringer construction
112 Access panels
113 Pressure refuelling connection
114 Doppler equipment fairing
115 Main rotor blade honeycomb trailing-edge pockets
116 Composite skin panels
117 Ground-adjustable blade tab
118 Blade tip balance and tracking weight fairing
119 Glass/carbon fibre D-section blade spar
120 Twin gyromagnetic compass unit
121 Tailcone joint frame
122 Rear avionics equipment bay
123 Access door
124 Tailcone construction
125 ADF sense aerial
126 HF aerial cable
127 Talifin leading-edge slat
128 Starboard tailfin
129 Starboard rudder
130 Rudder control linkage
131 Fixed horizontal tailplane
132 Rear radar warning antennas
133 Rear Odd-rods IFFaerials
134 Aft-facing radome
135 Horizontal tailplane construction
136 Tailplane bracing strut
137 Port tailfin leading-edge slat
138 Port navigation light
139 Tailfin construction
140 Fin/tailplane joint rib
141 Composite rudder construction
142 Lower rotor blades (folded position)
143 Blade locking struts
144 Upper rotor blades (folded position)



One of two radar-equipped AS555Ns operated by the Colombian Navy is seen aboard the frigate ARC* Almirante Padilla *at Roosevelt Roads, Puerto Rico in July 1999. *Jim Winchester*

Aérospatiale AS350 and AS355

Naval Squirrels and Fennecs

A rare example of a skid-equipped shipboard helicopter, the Squirrel/Fennec in its various forms has served with a number of navies, mostly in Latin America.

More than 7,200 of the Squirrel family have been built in several countries, mostly for civil use, but there are significant numbers of military variants. The Aérospatiale AS350, F-WVKH, flew on 27 June 1974 powered by a Lycoming LTS.101 turboshaft. The second prototype and production AS350B had the Turboméca Arriel engine. American-built versions had Lycomings.

Twin-engined Squirrels began with the Alison 250-C20F-powered AS355E in 1979, which was militarised as the AS355M and redesignated AS555 Fennec from 1990. The AS55AN has Turboméca Arrius-1M engines.

Known in French as the Écureuil and in English the Squirrel, the single-engined variants were marketed in North America as the AStar and the twins as the TwinStar. In military use they are usually known as the Fennec (desert fox) or as the Esquilo (squirrel) in Latin America.

In 1984 the Royal Australian Navy (RAN) received six AS350BAs previously in use by the Australian Defence Force Helicopter School and equipped them with a lightweight Doppler navigation system. Operated by No 723 NAS, they could be fitted with a 7.62mm machine-gun in the door. Embarked on HMAS *Adelaide* and HMAS *Success* during the 1991 Gulf War, they carried out shipping surveillance, mine searches and provided top cover for helicopter boarding operations.Nicknamed the 'Battle Budgie' or the 'Cyril' the RAN's AS350s served for 33 years, finally being retired in December 2017.

The twin engine variant of the AS350, the AS355 Écureuil 2 first on flew on 27 September 1979, but production of the single-engined variants continued until 2016. The militarised AS355M was redesignated AS555 Fennec from 1990. Four were supplied to the Mexican Navy (Armada de Mexico) as the AS555AF in 1992.

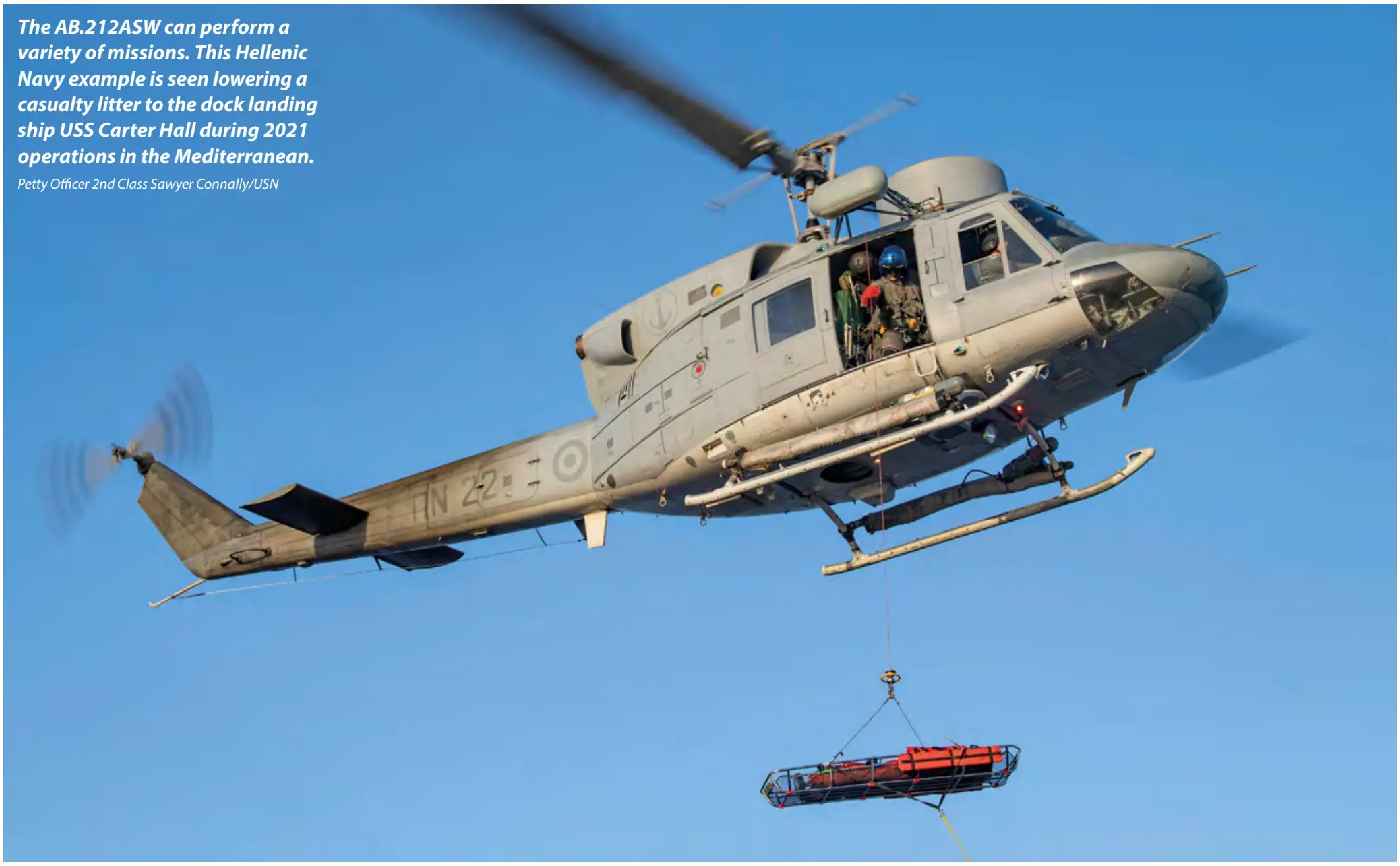
Helibras in Brazil built many AS350Bs and AS350L1s (AS550s) under licence. The Marinha do Brasil received nine, used by 1º *Esquadrão de Helicópteros de Emprego Geral* (No.1 General-Purpose Helicopter Squadron), later replaced by 11 HB355F2s. They could be armed with gun pods or rocket launchers, but were also embarked on Antarctic research vessels.

The AS555N is a dedicated naval variant for surface surveillance and over-the-horizon targeting (OTOH). It has a nose-mounted Telephonics RDR-1500B X-band digital radar with colour displays and 360 degree coverage. Argentina's Navy (Comando de Aviacion Naval Argentina) purchased four that replaced the Lynx Mk. 23 from 1996 with 1ra E*scuadrilla Aeronaval de Helicopteros*. Colombia's navy (*Armada Nacional de Colombia*) received two AS555Ns in 1998. Delivered in a mainly white colourscheme they were later camouflaged in two shades of grey and used by the *Grupo Aéronaval del Caribe*. One was written off in 2016.

The last-known customer was Royal Malaysian Navy (Tentera Laut Diraja Malaysia), which has used six with 502 Skuadron from 2004. The Squirrel/Fennec is still marketed at military customers as the AH-125 and MH-125 Ares, although maritime versions are not currently being offered by Airbus Helicopters. ■

Aérospatiale AS555N Fennec

Crew: One and up to five passengers
Fuselage length: 35ft 10in (10.93m)
Rotor diameter: 35ft 1in (10.69m)
Height: 3.34m)
Empty weight: 3,505lb (1,590kg)
All-up weight: 5,732lb (2,600kg)
Powerplant: Two Safran Helicopter Engines Arrius 1A turboshaft engines, each rated at 456hp (357kW)
Max speed: (278km/h)
Range: (720km)
Service ceiling: 20,000ft (6,096m)
Armament: One forward-firing M621 20mm cannon mounted on skid; rocket launchers ; door-mounted 7.62mm machine-gun



The AB.212ASW can perform a variety of missions. This Hellenic Navy example is seen lowering a casualty litter to the dock landing ship USS Carter Hall during 2021 operations in the Mediterranean. *Petty Officer 2nd Class Sawyer Connally/USN*

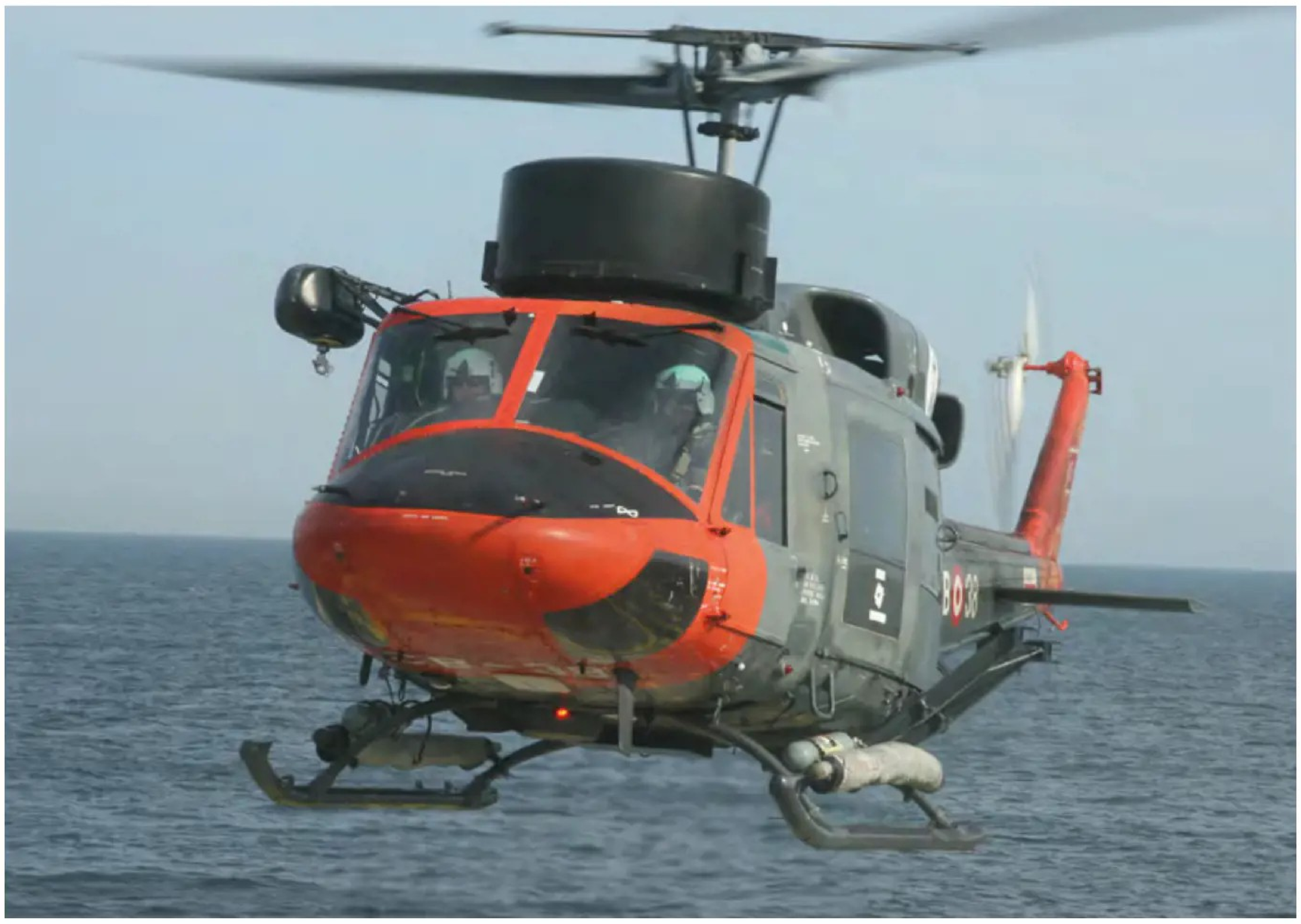
Agusta-Bell AB.212ASW

On the Skids

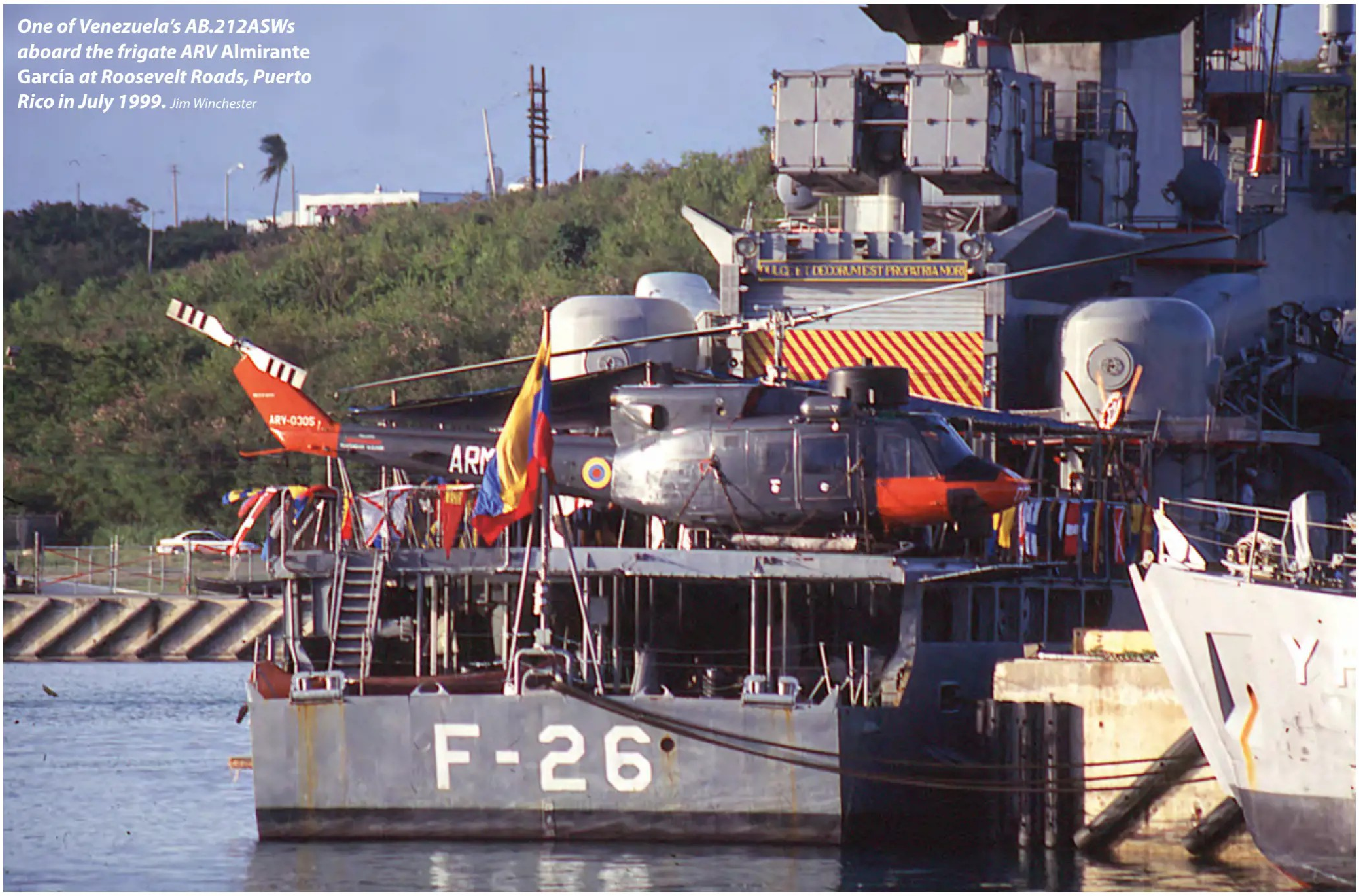
Modified by licence-builder Agusta, the 'Twin Huey' proved suitable as an ASW platform for shipboard use and for numerous other duties. Italy was the biggest user, but the AB212 sold to a number of other naval air arms.

Experience with the Bell 204 UH-1 'Huey' in Vietnam showed the benefits a twin-engined variant would bring to 'hot and high' operating conditions and for safety in overwater missions. Pratt & Whitney Canada teamed up with Bell to offer the Model 212 powered by two PT6T-3 turbines, which was ordered by the Canadian military in 1968. The US Navy, Marine Corps and Air Force followed suit by procuring the new UH-1N for various roles including combat rescue, assault transport and as a VIP 'taxi'. Over 40 air arms acquired the 'Twin Huey' in various forms.

Agusta in Italy built a single-seat helicopter for ASW in 1965, the A.106. It could operate from frigate decks and carry two torpedoes, but only two prototypes were flown. The company had long-standing licence agreement to produce Bell helicopters, including the Model 47



A Turkish Navy AB.212ASW landing aboard the Danish support ship HDMS* Esbern Snare *during a Joint Warrior exercise off Scotland in. April 2008. *Jim Winchester*



One of Venezuela's AB.212ASWs aboard the frigate ARV* Almirante García *at Roosevelt Roads, Puerto Rico in July 1999. *Jim Winchester*

Sioux and the UH-1 Iroquois. Some of the latter were produced in AB.204AS (*Anti Sommergibile)* configuration for anti-submarine warfare. Italy's Marina Militare Italiana took 35 of this version, the Spanish Navy operated four, and three were supplied to Turkey.

The AB.204AS was followed up with the AB.212ASW, based on the Bell 212 'Twin Huey'. This was originally a development of the Model 205 funded by Canada with PT6T-3 turbines in a 'Twinpac' arrangement. First flown in 1968, it was widely adopted by the US services and foreign users, and produced under licence by Agusta. As adopted for anti-submarine work, the AB.212ASW featured a large dorsal radome above the cockpit, an ASQ-13B dipping sonar system and the ability to employ various torpedoes and missiles. The first 12 Italian Navy aircraft had MEL ARI-5955 search radar in a domed radome above the cockpit. Subsequent examples had the MEL APS-705 (Sea Spray Mk. 1) radar in a cylindrical radome. This had a surface detection range of between 0.5-92 miles (0.9-148km). The AB.212ASW could be fitted with the LINK/TG-2 transmitter, an inertial guidance system for the Teseo ship-launched surface-to-surface missile.

Italy accepted 68 AB.212ASWs from 1973 and about two-dozen remain in service with 2° *Gruppo Elicotteri* at Catania.

The 212 is unusual for a naval helicopter in having a skid landing gear. This provides good stability on the deck, but for movement and stowage requires the fitting of small handling wheels. The two-bladed rotor could not be folded for shipboard stowage, but could be aligned fore and aft, allowing hangarage on suitable ships.

In 1979 Greece purchased 13 examples: 11 AB.212ASWs and two AB.212EWs. These latter aircraft were equipped with the *Gufo* (Owl) electronic warfare system, which included jamming and electronic intelligence (Elint) capabilities. Hellenic Navy 212s took part in sanctions enforcement against Iraq in the run-up to the Gulf War. Turkey obtained three in 1978 with the original domed radome and 13 more in 1988, three of which were AB212EWs. Two of these and five ASWs are still operational.

The Peruvian Navy purchased six AB.212ASWs in 1978. They are now withdrawn. Venezuela acquired ten in 1980 of which three or four may remain active. From 1974 the Spanish Navy received 14 AB212s, known locally as *Gato* (Cat). Some were in utility/SAR fit and others with ASW equipment. In 2016 Spain announced an upgrade programme to keep the ASW-configured aircraft in service another 15 years with a new maritime surveillance radar, a high-resolution EO/IR sensor and a 'glass' cockpit. In 2025 Spain's utility versions were replaced by NH90s.

On the eve of the Islamic Revolution, Iran took delivery of ten AB.212ASWs. They reportedly used AS.12 missiles against Iraqi ships and armoured vehicles during the Iran-Iraq War. As many as eight remain in the IRIN's inventory. Iraq ordered ten in 1983 but these were embargoed and never delivered. ■

Agusta-Bell AB.212ASW

Crew: Three
Fuselage length: 42ft 5in (12.92m)
Rotor diameter: 48ft 0in (14.63m)
Height: 12ft 10in (3.91m)
Empty weight: 7,524lb (3,420kg)
All-up weight: 11,154lb (5,070kg)
Powerplant: One Pratt & Whitney Canada PT-6T-6 Turbo Twin Pac turboshaft engine rated at 1,875hp (1,398kW)
Max speed: 150mph (240km/h)
Range: 414 miles (667km)
Service ceiling: 10,500ft (3,200m)
Armament: Two Mk 46 or Motofides 244AS torpedoes or two MARTE 2 or two Sea Skua Anti-ship missiles

A S-70B of 351/352 Filo flies above a Turkish Type 209 submarine during the Mavi Balina international ASW exercise held in the Eastern Mediterranean in November 2016.

Photo: CPO Christian Valverde/Nato Marcom

Sikorsky S-70 Seahawk

Hawks over the Oceans

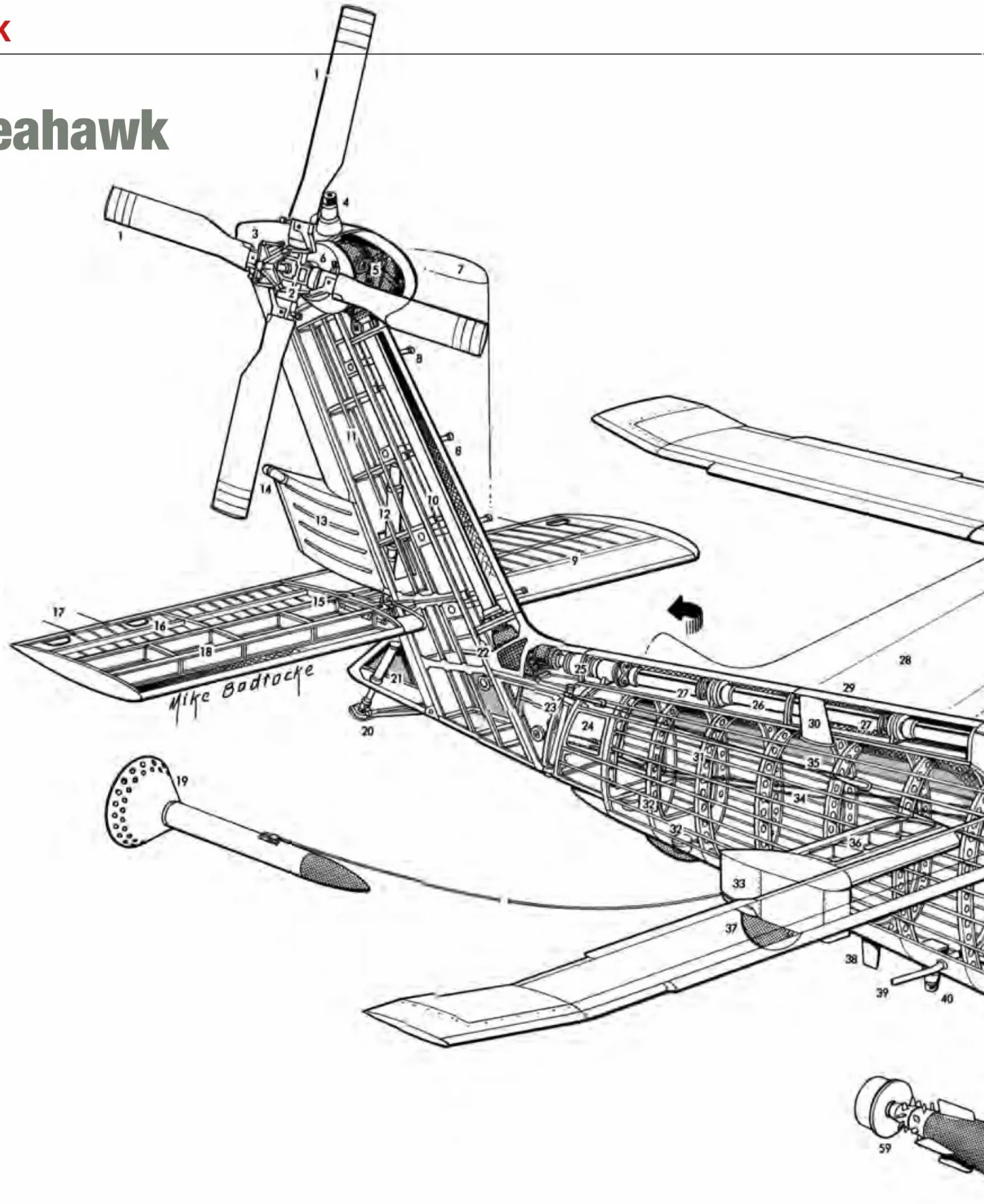
For more than 40 years Sikorsky SH/MH-60 Seahawk variants have served at sea aboard warships of the US Navy. Adapted for various roles, the Seahawk has been produced in six distinct versions for the US, while it has been exported to around a dozen countries.

The S-70B Seahawk was designed as a shipborne platform to replace the Kaman SH-2 Seasprite Light Airborne Multi-Purpose System (LAMPS) Mk I for the Helicopter Anti-Submarine Squadron, Light (HSL) units of the US Navy, primarily to serve on frigates, destroyers and cruisers. A larger platform was required for LAMPS Mk III, able to operate over longer ranges, with a greater loiter time and endurance.

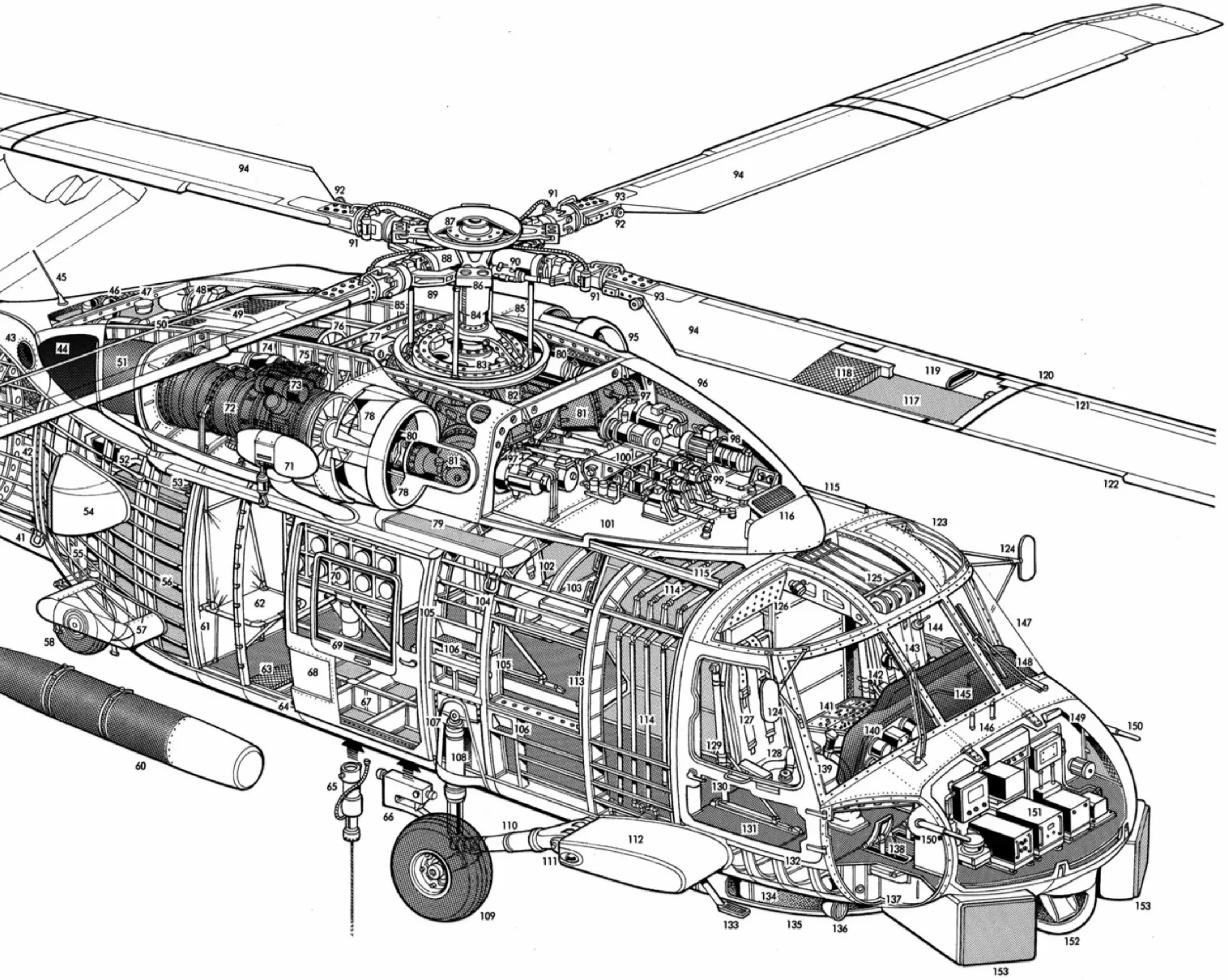
One of the five YSH-60B Seahawks on the flight line at NAS Patuxent River, Maryland in June 1983. *US Navy/NARA*

In 1977 the US Navy selected the S-70B airframe, based on the S-70A chosen by the Army as the UH-60A Blackhawk as its new tactical transport helicopter. Changes to the airframe included the ability to fold the blades and rear fuselage and a repositioned rear landing gear,– all adopted to reduce the helicopter's footprint while embarked on a warship – plus corrosion protection from the maritime environment. A more powerful General Electric T700 engine would power the S-70B and fuel capacity was increased, while the port cabin door was deleted. Two weapons pylons for torpedoes or other munitions were fitted, along with a 25-tube sonobuoy launcher. Sensors included an AN/APS-124 search radar, AN/ALQ-142 electronic support measures

Sikorsky SH-60B Seahawk



1 Graphite epoxy composite tail rotor blades
2 Lightweight cross beam rotor hub
3 Blade pitch change spider
4 Anti-collision light
5 Tail rotor final drive bevel gearbox
6 Rotor hub canted 20 degrees
7 Horizontal tailplane folded position
8 Pull-out maintenance steps
9 Port tailplane
10 Tail rotor drive shaft
11 Fin pylon construction
12 Tailplane hydraulic jack
13 Cambered trailing-edge section
14 Tail navigation light
15 Tailplane hinge joint (manual folding)
16 Handgrips
17 Static dischargers
18 Starboard tailplane construction
19 Towed magnetic anomaly detector (MAD)
20 Tail bumper
21 Shock absorber strut
22 Bevel drive gearbox
23 Tail pylon latch joint
24 Tail pylon hinge frame (manual folding)
25 Transmission shaft disconnect
26 Tail rotor transmission shaft
27 Shaft bearings
28 Tail pylon folded position
29 Dorsal spine fairing
30 UHF aerial
31 Tailcone frame and stringer construction
32 Magnetic compass remote transmitters
33 MAD detector housing and reeling unit
34 Tail rotor control cables
35 HF aerial cable
36 MAD unit fixed pylon
37 Ventral data link antenna housing
38 Lower UHF/TACAN aerial
39 Fuel jettison
40 Anti-collision light
41 Tie-down shackle
42 Tailcone joint frame
43 Air system heat exchanger exhaust
44 Engine exhaust shroud
45 Emergency locator aerial
46 Engine fire suppression bottles
47 IFF aerial
48 Port side auxiliary power unit (APU)
49 Oil cover exhaust grille
50 Starboard side air conditioning plant
51 Engine exhaust pipe
52 HF radio equipment bay
53 Sliding cabin door rail
54 Aft AN/ALQ-142 ESM aerial fairing, port and starboard
55 Tailwheel leg strut
56 Fireproof fuel tanks, port and starboard, total capacity 361 US gal (1,367 litres)
57 Starboard stores pylon
58 Castoring twin tail wheels
59 Torpedo parachute housing
60 Mk. 46 lightweight torpedo
61 Cabin rear bulkhead
62 Passenger seat
63 Honeycomb cabin floor panelling
64 Sliding cabin door
65 Recovery Assist, Secure and Traverse (RAST) aircraft haul-down fitting
66 Ventral cargo hook, 6,000lb (2,722kg) capacity
67 Floor beam construction
68 Spring-loaded door segment in way of stores pylon
69 Pull-out emergency exit window panel
70 Pneumatic sonobuoy launch rack (125 sonobuoys)
71 Rescue hoist/winch
72 General Electric T700-GE-401 turboshaft engine
73 Engine accessory equipment gearbox
74 Intake particle separator air duct
75 Engine bay firewall
76 Oil cooler fan
77 Rotor brake unit
78 Engine intake ducts
79 Maintenance step
80 Engine drive shafts
81 Bevel drive gearboxes
82 Central main reduction gearbox
83 Rotor control swash plate
84 Rotor mast
85 Blade pitch control rods
86 Bi-filar vibration absorber
87 Rotor head fairing
88 Main rotor head (elastomeric, non-lubricated, bearings)
89 Blade pitch control horn
90 Lead-lag damper
91 Individual blade folding joints, electrically operated
92 Blade spar crack detectors
93 Blade root attachment joints
94 Main rotor composite blades
95 Port engine intake
96 Control equipment sliding access cover
98 Hydraulic pump
99 Flight control servo units
100 Flight control hydro-mechanical mixer unit
101 Cabin roof panelling
102 Radar operator's seat
103 AN/APS-124 radar console
104 Tie-down shackle
105 Gearbox and engine mounting main frames
106 Maintenance steps
107 Main undercarriage leg mounting
108 Shock absorber leg strut
109 Starboard mainwheel
110 Pivoted axle beam
111 Starboard navigation light
112 Cockpit step/main axle fairing
113 Forward cabin access panel
114 Collective and cyclic pitch control rods
115 Sliding fairing guide rails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116 Cooling air grille
117 Main rotor blade glass-fibre skins
118 Honeycomb trailing-edge skins
119 Titanium tube blade gear
120 Rotor blade drooped leading edge
121 Leading-edge anti-erosion sheathing
122 Fixed trailing-edge tab
123 Cockpit eyebrow window
124 Rear-view mirrors
125 Overhead engine throttle and fuel cock control levers
126 Circuit breaker panel
127 Pilot's seat
128 Safety harness
129 Crash-resistant seat mounting
130 Pull-out emergency exit window panel
131 Flight deck floor level
132 Cockpit door
133 Boarding step
134 AN/APS-124 search radar antenna
135 Ventral radome
136 Retractable landing/hovering lamp
137 Downward vision window
138 Yaw control rudder pedals
139 Cyclic pitch control column
140 Instrument panel
141 Centre instrument console
142 Stand-by compass
143 ATO/co-pilot's seat
144 Outside air temperature gauge
145 Instrument panel shroud
146 Air data probes
147 Windscreen panels
148 Windscreen wipers
149 Hinged nose compartment access
150 Pitot tubes
151 Avionics equipment bay
152 Forward datalink antennas
153 Forward AN/ALQ-142 ESM aerial housings

(ESM) and a towed magnetic anomaly detector (MAD), while a forward looking infrared (FLIR) 'ball' could be mounted under the nose. The crew would comprise a pilot, a co-pilot/airborne tactical officer and a sensor operator.

Five YSH-60B prototypes were ordered, with the first flying on 12 December 1979. Production of an initial batch of 12 was authorised in Fiscal Year 1982, with the first SH-60B flying on 11 February 1983. It was delivered to the US Navy that month, going to HSL-41 at NAS North Island, California, and initial operational deployments by the Seahawk were undertaken by HSL-43 in 1985.

Six US Navy HSLs had been equipped with the Seahawk by the summer of 1987, comprising HSL-41, -43 and -45 home based at NAS North Island and -40, -42 and -44 at NAS Mayport, Florida. SH-60Bs were deployed in ones and twos to various warships, becoming an integral part of the vessel's capabilities. Although Seasprites continued to operate from smaller warships unable to accommodate the SH-60B, the retirement of the last 'Knox'-class frigates in 1994 allowed the last SH-2Fs to be retired that April, leaving a small number of SH-2Gs with the US Navy Reserve. After these were withdrawn in mid-2001, the SH-60B became the service's sole shipborne ASW helicopter.

A total of 181 SH-60Bs was built, excluding the prototypes. The last active-duty deployment by the model was concluded in late 2015 onboard the 'Oliver Hazard Perry'-class frigate USS Gary. The SH-60B was officially retired by the US Navy on 11 May 2015.

While the SH-60B was created to extend the reach and capabilities of the Navy's surface fleet, a separate requirement existed to screen aircraft carrier battle groups from enemy submarines. Long-range protection was the job of the Lockheed S-3 Viking, while Sikorsky SH-3H Sea Kings operated within the 'inner zone'. From March 1985 the SH-60F 'Ocean Hawk' was developed as the CV Inner Zone ASW helicopter as a replacement for the SH-3H. A total of 175 was originally sought.

The SH-60F dispensed with the LAMPS Mk III avionics, sensors and sonobuoy launcher, instead carrying an integrated ASW mission system with an AN/AQS-13F dipping sonar. The 'Ocean Hawk' would also become the standard 'plane guard' for carrier operations, equipped with a rescue hoist.

A YSH-60B was modified as the prototype, while the initial production SH-60F flew on 19 March 1987. The first operational unit to receive the model was Helicopter Anti-Submarine Squadron (HS) 10 at NAS North Island on 22 June 1989. Sikorsky built 82 SH-60Fs for the Navy, the last of which was delivered in 1994.

Developed in parallel with the SH-60F was the HH-60H, a strike/rescue/special warfare support helicopter. The first flew on 17 August 1988 and deliveries began the following year, equipping the US Navy Reserve Helicopter Combat Support Squadrons (HCS)-4 (later HCS-84) and -5. In service, HH-60Hs were also assigned to deployed HS units, alongside their SH-60Fs. A total of 42 HH-60Hs was built.

HCS-5 disestablished at the end of 2006, while HCS-85 received HH-60Hs in 2011 to replace its MH-60Ss. The final operational deployment by both the HH-60H and SH-60F was on the USS Theodore Roosevelt in late November 2015.

A search and rescue variant of the HH-60H was produced for the US Coast Guard as the HH-60J Jayhawk to fulfil the medium range recovery requirement. It lacked the self-defence electronics, infrared suppressors and ESM gear of the HH-60H, but retained the cabin doors on each side of that model, as well as the NVG-compatible cockpit. A Bendix-King RDR-1300 search and weather radar in a thimble radome was mounted on the nose, plus an external hoist on the starboard side. The standard crew was a pilot, co-pilot, flight engineer/hoist operator and rescue swimmer.

One of the RAN's S-70B-2s flies with a RN Merlin HM.1 in 2005. The Australian Seahawks were retired in 2017 after 28 service without major mishap.

L Phot Darren Macdonald/Crown Copyright

Hellfire-armed SH-60Fs of HS-11, assigned to USS* Theodore Roosevelt *aboard USS* Shreveport *during Operation Enduring Freedom activities in December 2001. *US Navy/David C. Mercil*

Japan is the biggest export user of the Seahawk, with over 160 built by Kawasaki for the JMSDF. This SH-60J of 21 Kokutai was pictured at Iruma in November 2015. *Jim Winchester*

The Jayhawk prototype completed its maiden flight on 8 August 1990 and entered service with the Coast Guard in July 1991. The service received 42 HH-60Js, some of which were later equipped with light machine guns and sniper rifles as MH-60Js to tackle 'go-fast' smuggling boats. Between January 2007 and mid-2018 41 HH-60Js underwent a service life extension with upgraded engines, a Collins Common Avionics Architecture System 'glass' cockpit, and new radar and FLIR. Six SH-60Fs were also modified as MH-60Ts to make good on attrition.

In 1993 the US Navy decided to end production of the SH-60B and 'F and remanufacture the fleet, as well as the HH-60Hs, to the upgraded SH-60R configuration as the LAMPS Block II. The SH-60R would combine the capabilities of SH-60B with the dipping sonar of the SH-60F – although upgraded to the AN/AQS-22 unit – while being tailored for littoral warfare operations. An AN/APS-147 radar, AN/ALQ-210 ESM and AN/AAS-44 FLIR would be installed. The MAD was deleted, but the ability to carry and fire AGM-114 Hellfires added. A new 'glass' cockpit was developed by Lockheed Martin.

Two SH-60Bs were modified as SH-60R prototypes, the first flying at Owego, New York, on 11 December 1999, with a two-year developmental test programme starting in May 2000. The prototypes were joined by a pair of engineering development model aircraft from July 2001 and February 2002, then five low-rate initial production (LRIP) I examples, all remanufactured from existing airframes. In mid-2001 the designation changed to MH-60R, while the increasing cost of the remanufacturing process and delays resulted in the decision to being taken to acquire new airframes instead from LRIP II. The first 'new' MH-60R flew on 28 July 2005, but it was the second that was the initial one to go to the US Navy, arriving at NAS Patuxent River, Maryland, on 31 March 2006 for HX-21.

Full-rate production started in Fiscal Year 2006 following the completion of an operational evaluation in September 2005, with deliveries to Helicopter Maritime Strike Squadron (HSM)-41 at NAS North Island beginning that December. The existing HSLs were redesignated HSMs, with the intention of having 18 such squadrons with MH-60Rs.

The first deployment of the MH-60R was aboard the aircraft carrier USS John C Stennis, undertaken by HSM-71 between January and July 2009. The 50th MH-60R was completed in March 2013, the 200th in November 2014 and a total of 278 was delivered to the US Navy by the end of 2016.

Under the US Navy Helicopter Master Plan that created the MH-60R, the service aimed to reduce the number of helicopter types in service from seven to two. A single model was required for the 'support missions', including vertical replenishment, combat/search and rescue and mine countermeasures to replace Boeing CH/HH-46D Sea Knights, Sikorsky M/CH-53E Sea Stallions, SH-3s and HH-60Hs.

A modified UH-60L was tested at sea in June 1995 and work on a dedicated naval variant began in October 1996 as the CH-60S 'Knighthawk'. It was a development of the UH-60L, but with the T700-GE-401C engine and dynamics of the SH-60B; blade and tail pylon folding; a rescue hoist; cargo handling system, and the 'glass cockpit' of the SH-60R. The YCH-60S prototype, a modified UH-60L airframe, first flew on 6 October 1997 and the decision to proceed to LRIP came in early 1998. On 27 January 2000 the CH-60S completed its maiden flight, while it was redesignated the MH-60S in February 2001.

The US Navy wanted 275 MH-60Ss. The first squadron with the model was HC-3 at NAS North Island in late 2001, followed by HC-5 at Andersen AFB, Guam, the latter completing the maiden operational deployment by the 'Knighthawk' on the 'Wasp'-class Landing Helicopter Dock USS *Essex* in late January 2003. The 50th MH-60S was delivered in June 2003. In

An underslung load is hitched to an MH-60R of HSM-77 'Saberhawks' aboard a destroyer in the Arabian Sea in April 2012. The 'Romeo' replaced the CH-46 in the vertical replenishment (Vertrep) role. *MC3 Tim D. Godbee/USN*

2005/2006 existing Helicopter Combat Support (HC) squadrons were retitled Helicopter Sea Combat (HSC) units as they re-equipped with MH-60Ss. Ten HSs also became HSMs, while HSC-22 and -23 were formed, for a total of 18 HSMs. Production of MH-60Ss for the US Navy was completed in 2016.

The Seahawk has been widely exported. Australia became the first overseas customer, acquiring two batches of eight S-70B-2s, ordered in October 1984 and May 1986, to operate from its 'Adelaide'-class guided missile frigates. The second eight were assembled by ASTA in Australia. The first was delivered to RAN Air Station Nowra, New South Wales, in February 1989, while a mid-life upgrade was completed on the fleet in 2004/2005. Australia also became the initial export customer for the MH-60R, ordering 24 in 2011 delivered from 2014, allowing the S-70B-2s to be retired at the end of 2017. Further contracts for 13 were placed to replace NHIndustries MRH90 Taipans.

From December 1988, the Spanish Navy operated 12 S-70B-1s, later augmented by six SH-60Fs from the US Navy, with eight MH-60Rs ordered in October 2023. Brazil received six S-70Bs, operating them as SH-16s with HS-1. Eleven S-70B-6 Aegean Hawks, a hybrid between the SH-60B and 'F, were delivered to the Hellenic Navy, while the first three of seven MH-60Rs on order were handed over in March 2024. No.123 Squadron of the Republic of Singapore Air Force has eight S-70Bs. The Royal Thai Navy received eight S-70Bs, as well as becoming the first overseas customer for the MH-60S, receiving two from August 2011. A total of 26 S-70B-28s were delivered to Turkish Naval Forces for 351/352 Filo.

The Republic China's Seahawks were designated S-70C(M)-1s and -2s, in the pretence they were versions of the commercial C-model. The two versions are both known as Thunderhawks, powered by the civil CT7-2D1 and military T700-GE-401C turboshafts, respectively.

Mitsubishi acquired a licence to build the Seahawk for the Japan Maritime Self Defense Force (JMSDF) to replace HSS-2B Sea Kings. Combing some features of the SH-60B and 'F, the SH-60J had a Japanese-designed mission suite and dipping sonar. Sikorsky built two prototype XSH-60Js, the first flying on 31 August 1987 and deliveries of production examples by Mitsubishi began four years later. Around 100 entered service.

Development of an upgraded version as the SH-60Kai began in 1997, but by the time two SH-60Ks had been modified as prototypes and the first, hovering flight completed, on 8 August 2001, it had become the SH-60J. The SH-60J had a slightly larger cabin, more powerful T700 engines turning a new main rotor, improved avionics and mission systems. Deliveries to the JMSDF began on 10 August 2005 and 76 were handed over, including the prototypes.

Quieter, more advanced Russian and Chinese submarines, the introduction of the Type 12 torpedo, and experience combating pirates off the coast of Somalia from 2007 using SH-60J/Ks, highlighted potential areas for upgrade. Work on these began in 2015, resulting in the first of two XSH-60L prototypes flying on 11 May 2021; development had been completed by the end of 2023 and at least 12 ordered by 2025.

In addition to the nations mentioned above, the MH-60R has been delivered to Denmark (Esk 723 having nine), while India ordered 24 in 2020 for INAS334, with deliveries continuing in 2025. The Republic of Korea Navy's 62 Maritime Helicopter Group is due to receive 12 MH-60Rs, with the first three delivered in 2024, while the Royal Saudi Navy accepted ten, their crews training with HSM-40 in the late 2010s. Six MH-60Rs have been ordered for the Norwegian Coast Guard while New Zealand intends to have five, having selected the variant in August 2025. ■

Sikorsky MH-60R Seahawk

Crew: Three (pilot, co-pilot, sensor operator)
Fuselage length: 50ft 1in (15.26m)
Rotor diameter: 53ft 8in (16.36m)
Height: 17ft 0in (5.18m)
Empty weight: 15,170lb (6,881kg)
All-up weight: 23,500lb (10,659m)
Powerplant: Two General Electric T700-GE-401C turboshafts, rated at 1,800shp (1,342kW) each
Max speed: 205mph (333km/h)
Range: 540 miles (870km)
Service ceiling: 19,000ft (5,791m)
Armament: Up to three Mk 46, 50 or 54 torpedoes or AGM-119B Penguin Mk 2 anti-shipping missiles, or four AGM-114 Hellfire missiles; optional Advanced Precision Kill Weapon System rockets and door-mounted guns

The Chilean Navy's HU-1 squadron operates six Dauphins including this ex-Irish Air Corps AS365N. *Airbus*

Aérospatiale AS365/Airbus AS565

Dauphins, Dolphins and Panthers

There are more than 250 maritime Dauphins and Panthers in service worldwide, including nearly 100 HH-65 Dolphins with the U.S. Coast Guard. The type is also China's main light shipboard helicopter.

The Panther can trace its lineage to the Aérospatiale SA.360 Dauphin of 1972, which was largely unsuccessful on the civil market. A twin-engined development, the AS365 Dauphin 2, flew on 24 January 1975, it shared little in common with its predecessor except its general layout and a Fenestron tail rotor. The US Coast Guard was the biggest customer, ordering 96 as the HH-65A Dolphin in 1978. It was the first USCG aircraft that had not been in service with one of the other branches of the US military. Its foreign origin caused problems in that the Buy America Act required a certain amount of local content and the Turboméca Arriel engines had to be replaced by Textron Lycoming LTS 101-750A-1s, generating 680shp (507kW) each. With the Coast Guard's additional mission kit, the Dolphin was considered underpowered.

LANDHELGISGÆSLAN
TF-SIF
SA365N
CAT

An Icelandic Coast Guard Dauphin 2 hovers over a beach during a rescue effort for a stranded fishing trawler in 2004. **Islenska Landhelgisgaeslan** ***operated two AS365N2s between 1984 and 2007.*** NARA

SSgt. Anthony Lusi, USAF/NARA

The Royal Saudi Navy fields some of its Dauphins with Aragon radar and AS.15TT missile capability.

Petty Officer 1st Class Justin Wolpert/USN

Eventually after a long selection process, in 2004, the remaining aircraft were re-engined with the Arriel 2C2-2G, which provides 853shp (636kW) maximum continuous power. Together with seven new aircraft, these became HH-65Cs, later 97 Dolphins were upgraded to MH-53Es with a new 'glass' cockpit.

The militarised AS365M took its maiden flight in February 1984. It was powered by two Turboméca (now Safran) Arriel 1M1 turboshafts of 681shp (508kW) output. A more developed AS365K, named Panther, followed in 1986 and was marketed in different forms, including the military AS365SM and AS365F armed naval variant. These were later redesignated AS565s, with the 565SA being an ASW variant and the 565MA an unarmed naval SAR/utility variant. Saudi Arabia bought 24 AS365Fs in the early 1980s and later five civil-standard A365Ns, eventually passing four of them on to Djibouti. In 2009 they purchased six AS565s. Some of the Royal Saudi Navy aircraft have a Thomson-CSF Aragon radar scanner mounted on the nose which is used to guide AS.15TT anti-ship missiles.

The AS565MB is a naval version taking features from the civilian AS365N3 Dauphin 2 and has 852hp (635kW) Arriel 2C engines. Customers for the AS565 MB include the Moroccan, Saudi and Bulgarian navies. Mexico was the launch customer for the MBe version, which has also been purchased by the Indonesian Navy, which received the first of 11 AS565MBes in 2016 as kits. They were assembled and outfitted by PT Dirgantara Indonesia.

Naturally, France was a significant customer, the Aéronavale operating six AS365Ns, three AS365Fs, seven AS365N3s and two AS365N3+s for duties including SAR and aircraft carrier plane guard. The current production naval version, the AS565 MBe has Arriel 2N turboshaft engines giving 1,129shp (842kW), a 'glass' cockpit, a dual channel four-axis digital automatic flight control system (AFCS), and full authority digital engine control (FADEC). It can be armed with door guns, torpedoes and anti-shipping missiles such as the Anti-Navire Léger (ANL).

The Mexican Navy operates both the AS565MB and MBe. Equipment on both Mexican versions includes a main- and tail-rotor blade folding system, a winch, a deck-lock harpoon and an emergency flotation system. They are equipped with Bendix RDR-1500B search/weather radar and Star Safire IIA FLIR. A door gun can be fitted.

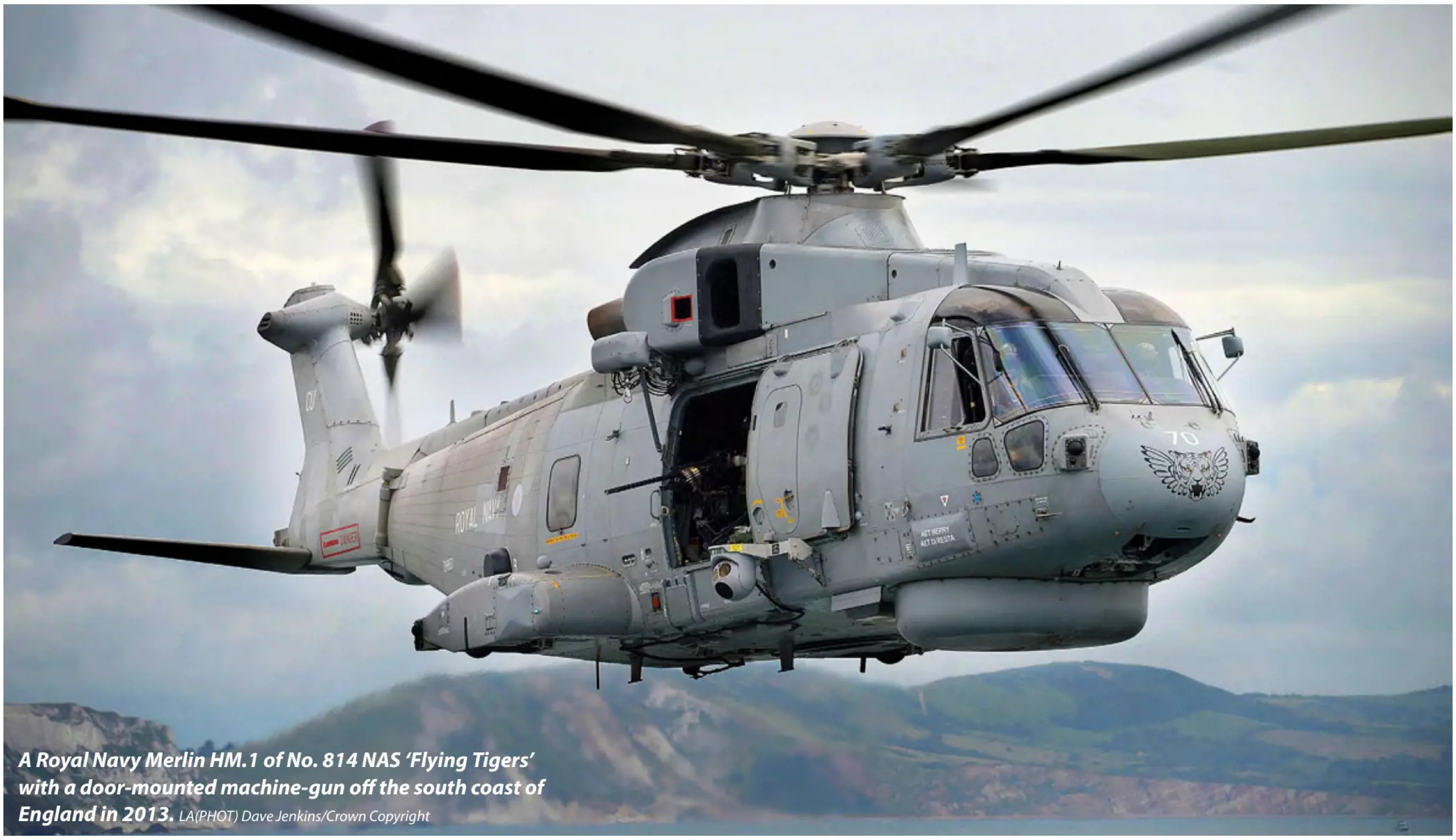
Israel's first and, for many years only, shipboard helicopter was the AS565MA Atalef (bat). Acquired in 1996 and deployed aboard 'Sa'ar 5'-class corvettes when needed. The surviving five of six were retired in 2024 with replacement being refurbished SH-60F Seahawks. The UAE Navy's six AS565MA and seven AS565SB aircraft were delivered from 1999. They equip the 'Baynunah'- and 'Abu Dhabi'-class patrol escort ships and now come under Joint Aviation Command (JAC). Several also have Aragon radar and AS.15 capability.

Other naval operators include the Moroccan Navy with three AS565MAs and Lithuania with three AS365N3+ Dauphins for SAR duties, delivered in 2015. The Bulgarian Navy ordered six AS 565MBs in 2005, but this was reduced to three aircraft for budgetary reasons.

China's Harbin Aircraft Industries Group (HAIG) has built a number of Aérospatiale/Eurocopter/Airbus designs under licence, including the AS365. Around 33 Z-9s are in service with the People's Liberation Army Naval Air Force (PLANAF), mostly Z-9Cs for ASW, but also Z-9Ss used for plane guard duties from the PLAN's three carriers. The Z-9CJ is used by the Naval Air University and the Z-9DF by the Marine Aviation Brigade. The China Coast Guard operates the Z-9A.China has exported the Z-9 to several air forces, mostly in Africa. ■

Airbus AS565MB

Crew: One or two; capacity for up to ten passengers
Fuselage length: 44ft 11in (13.68m)
Rotor diameter: 39ft 2in (11.94m)
Height: 13ft 0in (3.97m)
Empty weight: 5,247lb (2,380kg)
All-up weight: 9,450lb (4,300kg)
Powerplant: Two Turboméca Arriel 2C turboshafts, each rated at 852shp (635kW)
Max speed: 190mph (306km/h)
Range: 514 miles (827km)
Service ceiling: 19,242ft (5,865m)
Armament: Up to four AS.15TT anti-ship missiles; Mk 46 torpedoes; door-mounted machine-gun



A Royal Navy Merlin HM.1 of No. 814 NAS 'Flying Tigers' with a door-mounted machine-gun off the south coast of England in 2013. *LA(PHOT) Dave Jenkins/Crown Copyright*

Leonardo AW101 Merlin

Sub-Hunters and SAR Queens

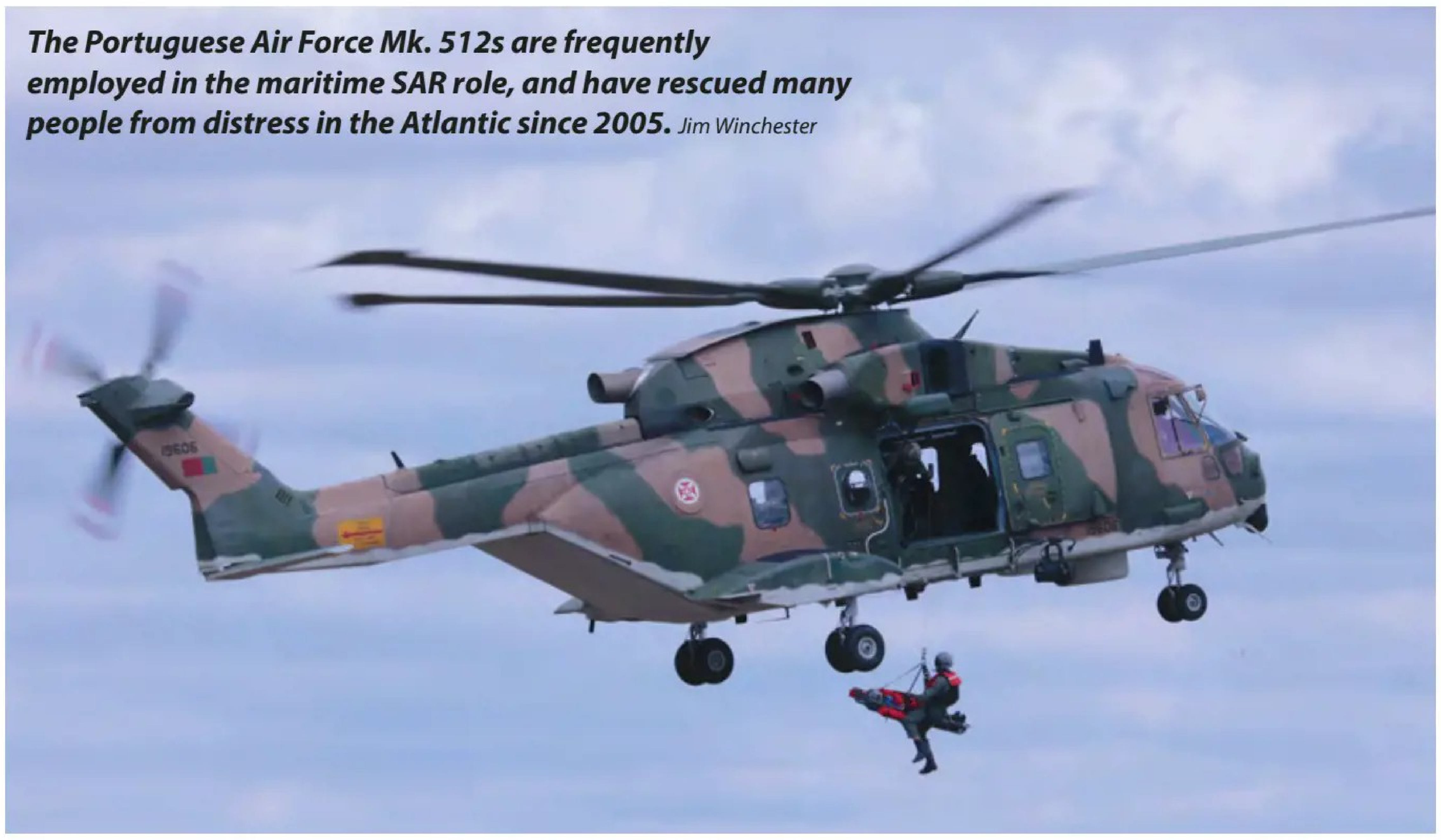
After a protracted development programme, the UK-Italian EH 101 has matured into a versatile helicopter for a variety of shipboard and land-based roles.

Work on a Sea King replacement for the Royal Navy began with the issuing of Naval Staff Requirement 6646 in 1976, with the Westland WG 34 selected for future development in September 1978. Around this time, the Italian Navy (Marina Militare) sought an eventual replacement for its Agusta-built ASH-61 Sea Kings.

The two navies subsequently merged their requirements and Westland and Agusta agreed to collaborate on a common basic design and a joint-venture company, European Helicopter Industries (EHI) was established in 1980. The Italians wanted a heavier aircraft than the WG.34 and work on this design was was stopped in October 1980 before a prototype was complete. EHI did not fully get going until 1984 when the two governments agreed to fund nine EH 101 prototypes. A possibly apocryphal story is that the aircraft was to be the EHI 01, but was mis-transcribed and became the EH 101. Service entry was then planned for 1992.

As the design progressed, it was realised that the basic airframe could be adapted to fulfil land-based utility roles and also had potential as a civilian airliner. Work on these three development paths progressed in parallel, with pre-production aircraft completed in the different configurations

The first prototype, PP1/ZF641 flew at Yeovil in the hands of Trevor Egginton and Colin Hague on 9 October 1997. Egginton and Ralf Longobardi piloted PP2's maiden flight at Cascina Costa on 26 November. The first in Royal Navy configuration (then called HAS.1) with a 360-degree radar under the forward cabin and ASW avionics was



The Portuguese Air Force Mk. 512s are frequently employed in the maritime SAR role, and have rescued many people from distress in the Atlantic since 2005. *Jim Winchester*

PP5, which flew in October 1989 and conducted its first shipboard landings, aboard HMS *Norfolk* in November 1990. PP2 was also tested aboard Italian 'Maestrale'-class frigates.

The programme suffered setbacks with the loss of two pre-production aircraft during testing. PP2 crashed after a rotor brake fire in January 1993, killing all four aboard, and PP4 crashed near Yeovil in 1994 after a tail rotor component failure. The four crew were able to parachute to safety, a rare occurrence in a helicopter emergency.

Construction was divided between the partners, with Westland producing the forward fuselage and cockpit, the main cabin and undercarriage and the installation of the three GE CT7-2A engines. Agusta was responsible for the rear fuselage, rotor head and electric and hydraulic systems. Fiat in Italy designed and produced the main gearbox. From PP4 the engines were replaced with RTM-322s.

Naval variants have powered blade folding and foldable tail sections. The utility variant has a modified rear fuselage with a loading ramp for embarking troops or light wheeled equipment.

As the Merlin HM.1, the EH 101 entered Royal Navy service with No.700M Squadron on 1 December 1998. The type training unit, No.824 Squadron formed out of 700M in March 1999 and the first operational squadron was No.814 Squadron, which was formed in September 2000 to supply carrier detachments for the 'Invincible'-class ships. No.700 Squadron continued as the type evaluation unit until 2008. Under the Merlin Capability Sustainment Programme, 30 HMA.1s were totally rewired, fitted with an enhanced Sea Spray radar, redesigned cockpit and given new tactical mission and aircraft management systems. The last was delivered by Lockheed Martin UK in July 2016. No.820 Squadron was formed in 2003 with the first HMA.2s and formed the flights for the 'Queen Elizabeth'-class carriers. No.829 Squadron stood up in October 2004 and supplied six flights for the Type 23 frigates. It merged with 814 in March 2018. The Royal AIr Force received 22 Merlin HC.3s with ramps and double-wheel landing gear from 2001, later adding six purchased from Denmark with radar noses as HC.3As. In 2014 they were transferred to the RN as a replacement for the Commando Helicopter Force's Sea King HC.4s. They have received folding rotor blades and tails, modified landing gear, a fast roping beam, a new tactical computer and upgraded flight controls. The first Merlin HC.4 flew on 31 October 2016 and the HC.4/4A equips Nos. 845 and 846 Squadrons at Yeovilton. The Crowsnest programme has seen Merlin HM.2s with Thales Searchwater radar replace the Sea King ASaC.7.

The first Italian Navy aircraft were delivered in 2000, with the last in 2009. The 22 aircraft are operated in several configurations: ten SH-101A (Mk. 110) ASW and ASuW; four EH-101A (Mk. 112) for AEW with HEW-784 radar in a large underfuselage radome; four UH-101A (Mk. 410) transports and four UH-101A (Mk. 413) amphibious support helicopters. The SH-101As can carry two MARTE anti-ship missiles, torpedoes or depth charges. The operating units are 1° and 3° *Gruppo Elicotteri* and the helicopters are deployed on ships of the 'Maestrale'-class and above. Italian Air Force special operations unit 1° Brigata Aerea Operazioni Speciali uses 12 examples of the HH-101A Caesar (Mk. 611), which are equipped with a nose radar, defensive guns and ECM equipment and can be fitted with a refuelling probe.

Agusta and Westland merged under the Finmeccanica group in 2000, becoming AgustaWestland and the EH 101 became the AW 101. The group was rebranded in 2016 as Leonardo, but helicopter designs have retained the AW prefix.

International sales prospects were once optimistically set at around 800 aircraft. They have yet to approach that figure, but the AW 101 has sold fairly well on the world market.

Canada showed interest in the EH 101 from the beginning, considering it in the late 1980s as a replacement for the Sea King in the maritime role and expressed a "firm intention" to buy 45 CH-148 Petrels for ASW and utility missions and up to 15 more CH-149 Chimo SAR aircraft. The orders were

After many years of procurement woes, the CH-149 Cormorant entered service with the Canadian Forces in 2002. This example was exercising with offshore patrol vessel HMCS* Harry DeWolf *in November 2020. Cpl David Veldman/Canadian Armed Forces

The RAF's Merlins were transferred to the Navy for the Commando role. HC.4 ZJ130 is seen on a Joint Personnel Recovery exercise in Norway with a Dutch NH90.

PO (Phot) Lee Blease/Crown Copyright

cancelled in 1993 with a change of government, but eventually, after several more twists and turns the first of 15 CH-149 Cormorants was delivered in October 2001 for SAR. They equip No. 103 Squadron at Gander, 413 Squadron at Greenwood, No. 424 Squadron at Trenton and No. 442 Squadron at Comox. Denmark has had 20 aircraft in service with Esk 722 since 2005. Of these, six were sold back to the Royal Air Force and replaced by new-build aircraft. Norway chose the AW 101 as its Sea King replacement in November 2013. The 16 aircraft serve at Sola, Ørland, Banak, and Bodø bases on SAR duties with No. 330 *Skvadron*. The type is known as the 'SAR Queen' in Royal Norwegian Air Force service.

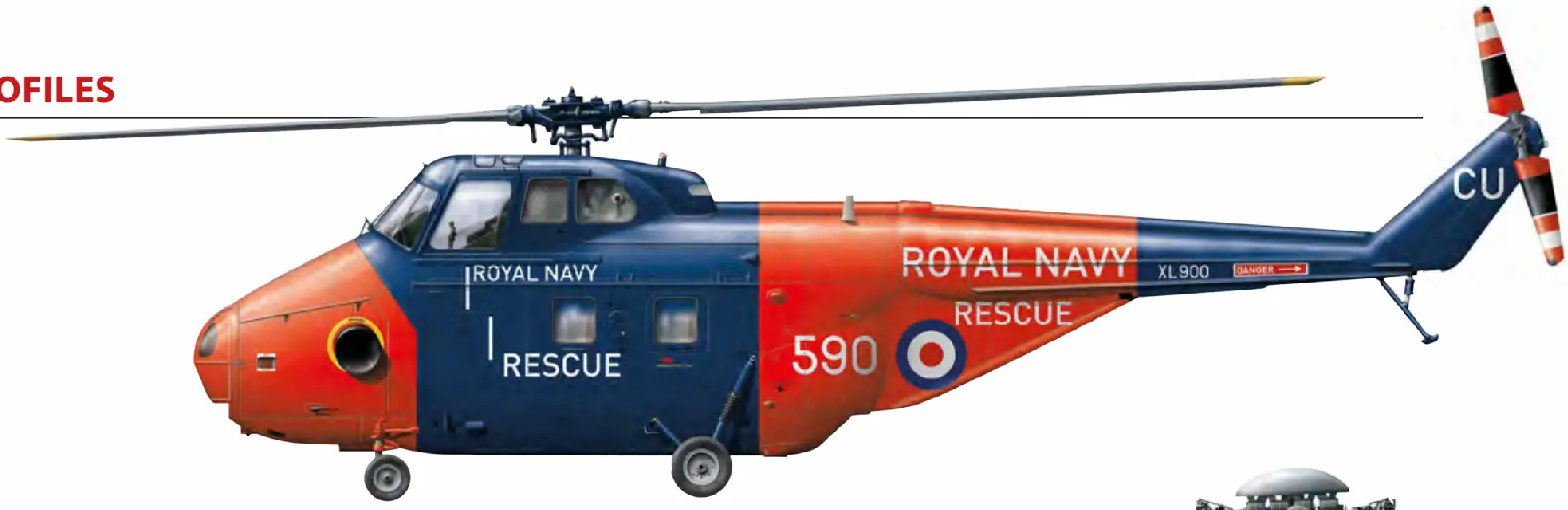
Portugal's 12 Mk. 515 aircraft are likewise land-based, although there was an aspiration to operate them from a new amphibious ship, which was cancelled due to budget cuts. Mostly used for SAR missions, two are assigned to the fisheries protection or SIFICAP (Sistema de Fiscalization de Pescas) mission and are fitted with external loudspeakers. In the cabin there are modular stations for a radar operator and a loudspeaker operator. The Polish Navy is potentially the largest customer outside the original partners, having contracted for four in 2019 and expressing an interest in a further 22 The first arrived in August 2023 and is operated by 44 Baza Lotnictwa Morskiego at Darlowo.

The Algerian National Navy signed a contract in November 2007 for six Mk. 610s for SAR and CSAR. They are operated by the 560ème Escadron de Recherche et Sauvetage, although two have been lost in accidents to date. The Algerian Air Force also operates two Mk. 642s in the VIP role. Turkmenistan's government has a single Mk. 643 in its Presidential Flight. India also ordered the AW 101 for VIP use, but only three of 12 aircraft were completed before the contract was cancelled. Efforts to replace the VH-3D Sea King as part of the US presidential support fleet resulted in the selection of the AW 101 as the VH-71 Kestrel, but cost overruns and politics saw the nine aircraft built sold to Canada for spare parts.

To replace the JMSDF's Sikorsky S-80s, Tokyo has purchased ten MCH-101s along with three CH-101 transports. All but two were assembled by Kawasaki Heavy Industries (KHI). For the minesweeping role, the MCH-101 is equipped with Northrop Grumman AN/AQS-24A airborne mine hunting system and the Northrop Grumman AN/AES-1 Airborne Laser Mine Detection System (ALMDS), which together provide mine-detection capability from the surface to the seabed. The first Yeovil-built MCH-101 flew in February 2005 and the first Japanese-assembled CH-101 in Japan in 2007. The CH-101s were acquired for operations aboard the Antarctic research vessel *Shirase*. ■

Leonardo Merlin HM.Mk 1

Crew: Three
Fuselage length: 74ft 10in (22.81m)
Rotor diameter: 61ft 0in (18.59m)
Height: 21ft 10in (6.65m)
Empty weight: 20,018lb (9,080kg)
All-up weight: 29,830lb (13,530kg)
Powerplants: Three Rolls-Royce/Turboméca RTM322-01 turboshafts, each rated at 2,312shp (1,724kW)
Max speed: 192 mph (209km/h
Range: 1,853 miles (1,152km) with auxiliary fuel
Service ceiling: 15,000ft (4,572m)
Armament: Four Stingray torpedoes or Mk 11 Mod 3 depth charges, or anti-ship missiles; one door-mounted 0.50in machine-gun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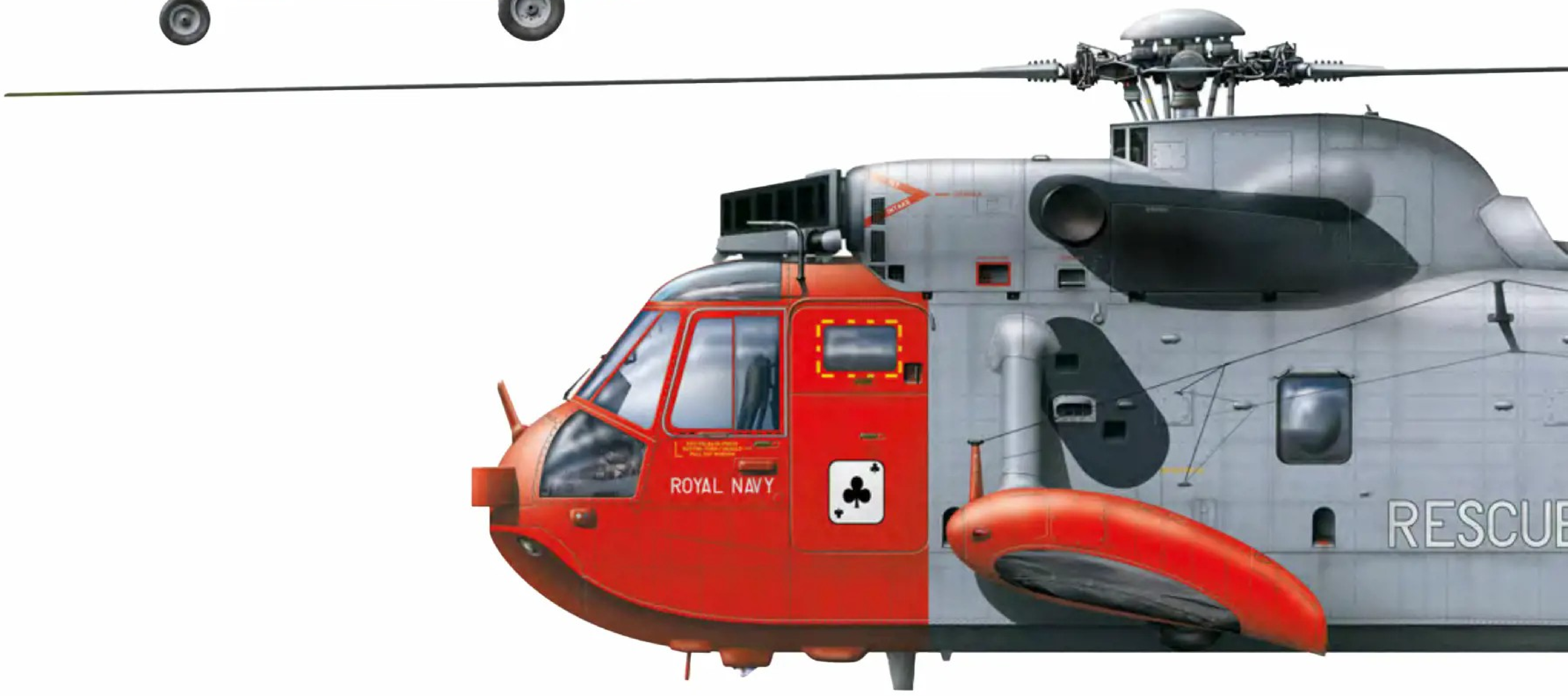
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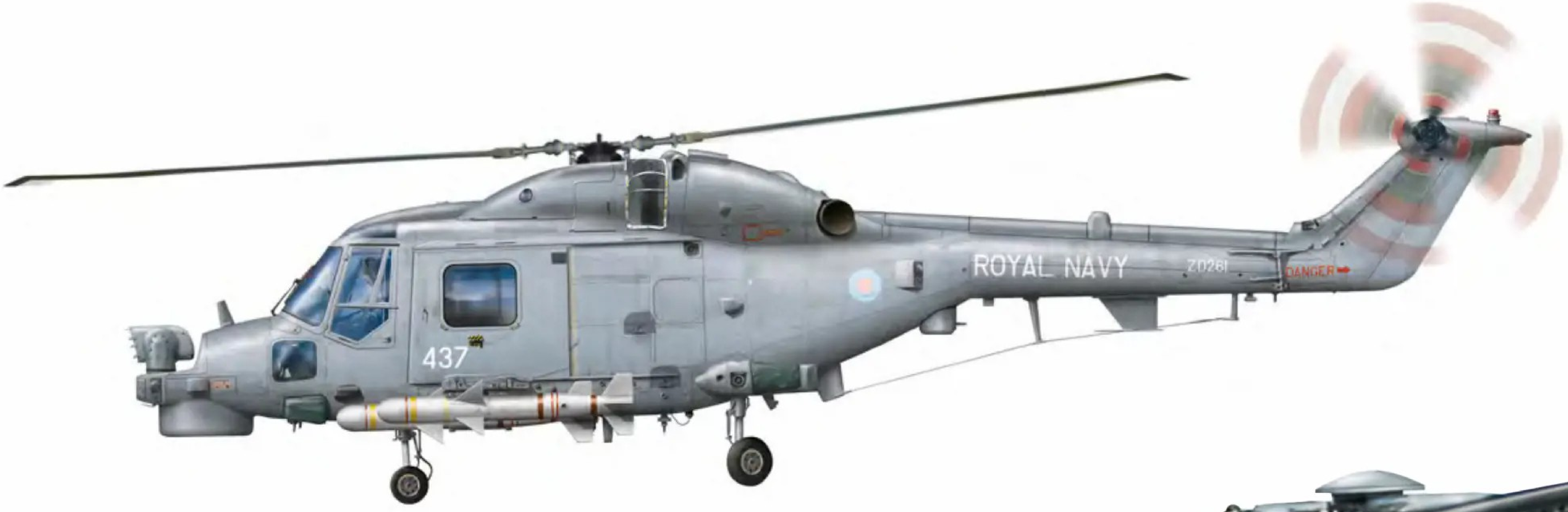
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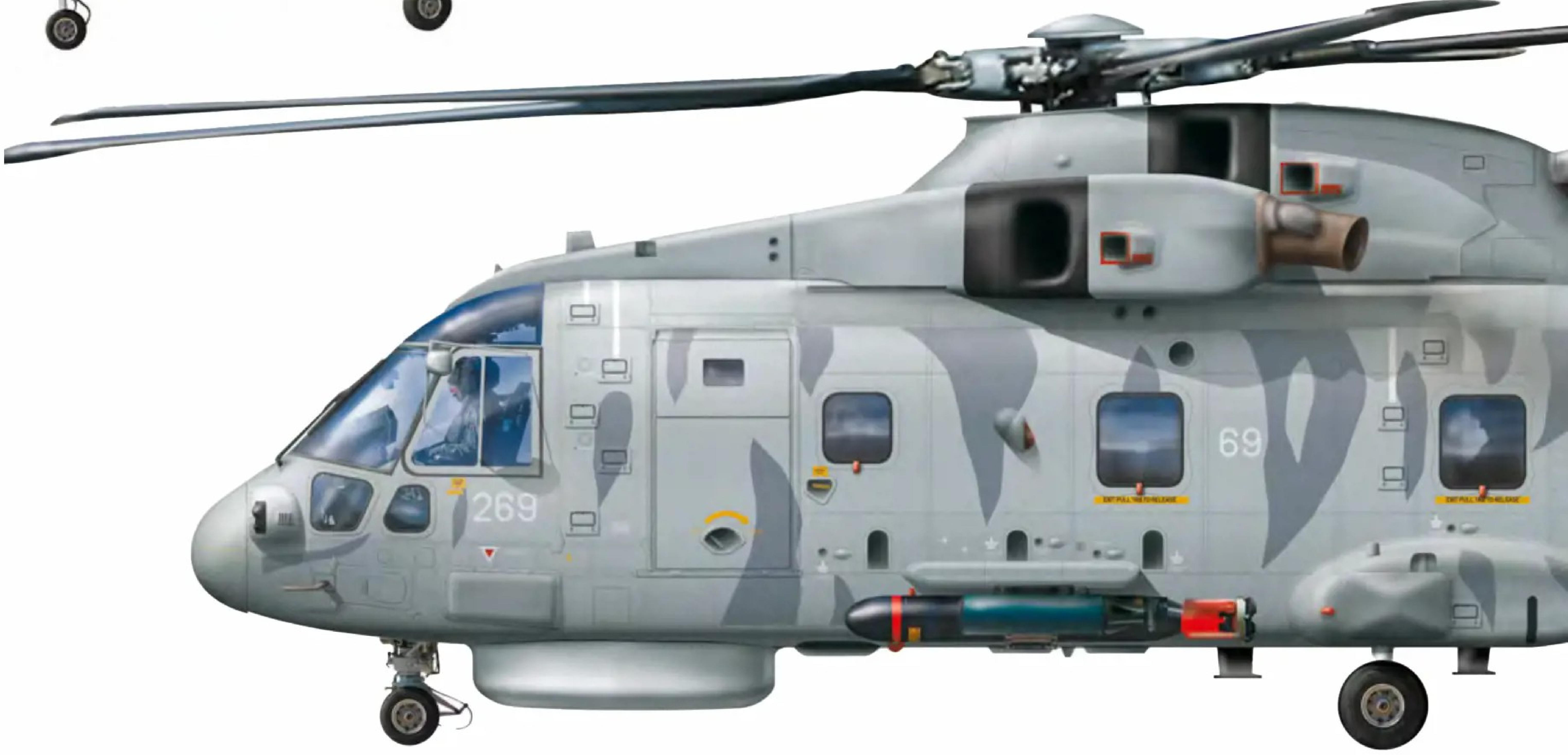
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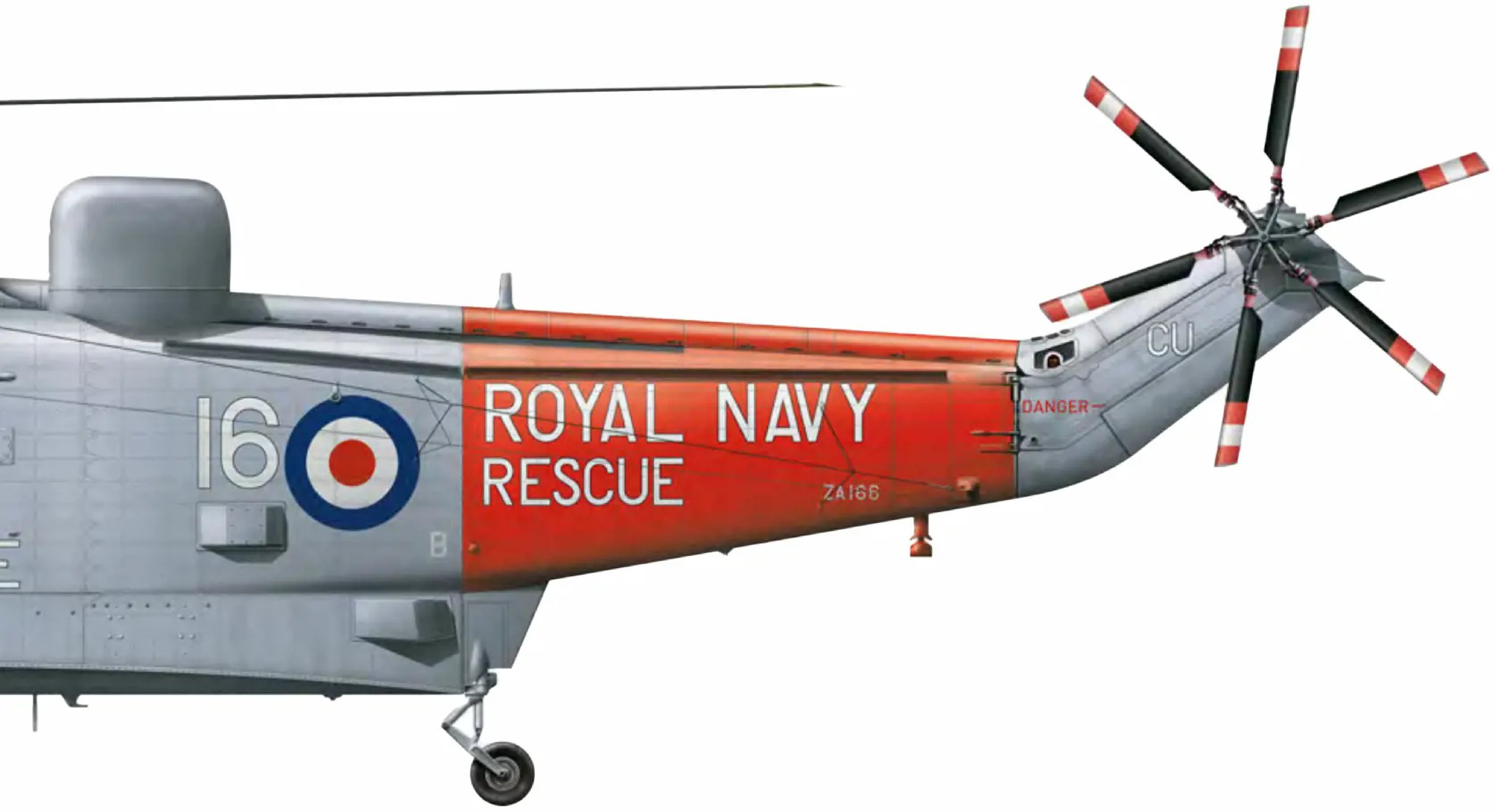
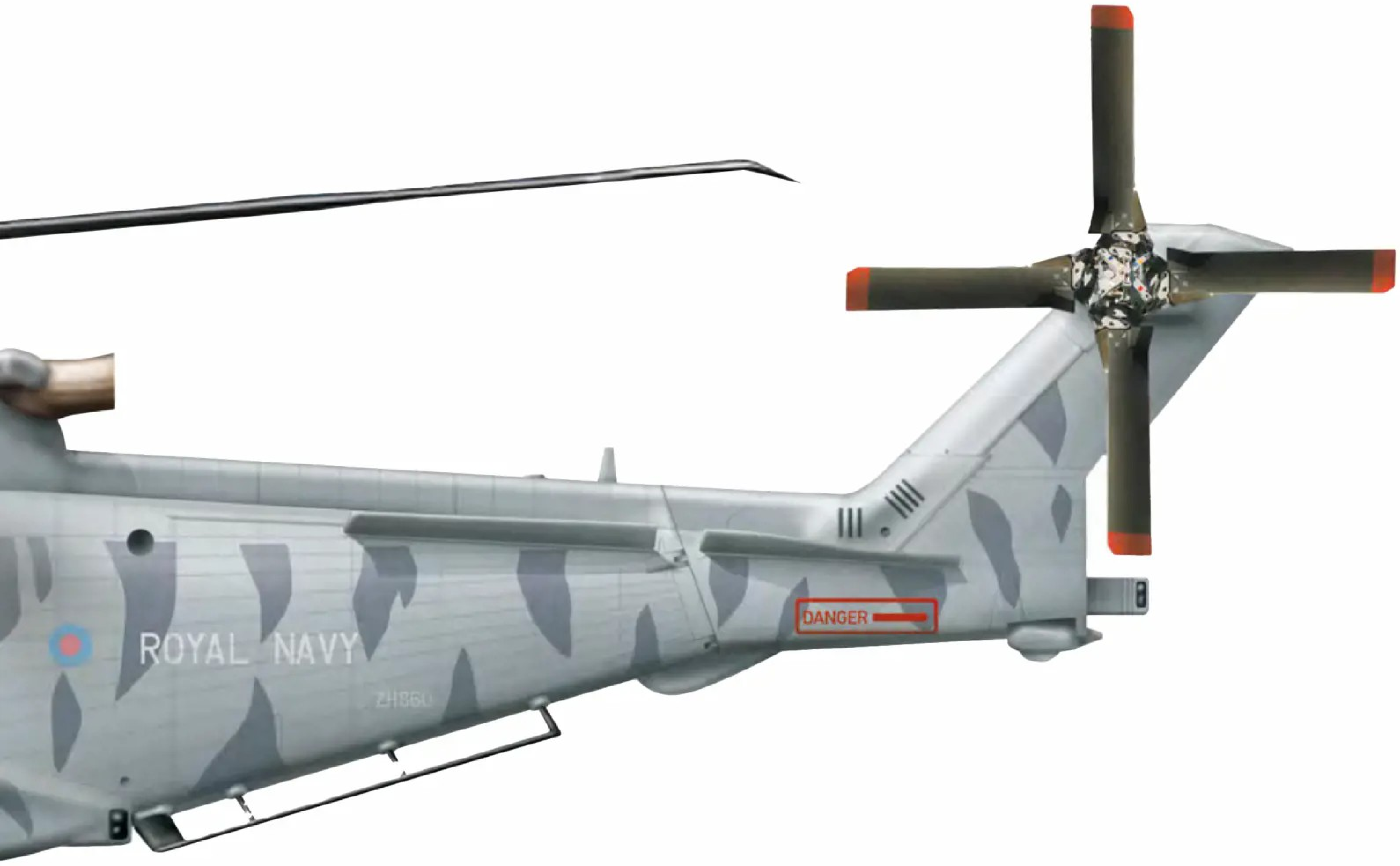


Westland Whirlwind HAS.7 XL900
C/n WA239
Culdrose SAR Flt
RNAS Culdrose, Cornwall 1972
Whirlwind HAS.7 XL900 made its first flight on 29 October 1958 and was delivered to the Fleet Air Arm a week later. Although its early service is obscure, it wore these markings from at least 1969. Converted to a turbine-engined HAR.9, it rolled over after an emergency landing at RNAS Culdrose on 21 November 1973, the root cause being a tail rotor gearbox failure. The wreckage was eventually taken to RNAY Fleetlands for spares recovery and scrapping.

Westland Sea King HU.5 ZA166
C/n WA.899
No. 771 NAS
RNAS Culdrose, Cornwall 2014
First flown on 4 March 1982 and delivered to the Royal Navy on 1 April, ZA166 was built as an anti-submarine HAS.5. Missing out on the Falklands War, it served in turn with with Nos. 824, 820, 706, 810, 771 NAS. In 2001 it was converted to HU.5U standard and issued to No. 849 NAS, then 820, 706 and 771 by 2004. A crewman won the Air Force Cross for the rescue of an injured yacht crew in August 1992. Leased to HeliOperations at Portland after the squadron disbanded in 2015 to train German Sea King crews, it was sold to the Ukrainian Navy in 2022.



Westland Lynx HMA.8 ZD261
C/n 295
No. 815 NAS
RNAS Yeovilton, Somerset, 2006
As a Lynx HAS.3, ZD261 first flew on 22 June 1983 and was delivered on 1 July. In the mid-1990s it was upgraded to Mk. 8 standard, eventually becoming a Lynx HMA.8 (SRU) with the Saturn Radio Upgrade package. It mostly flew with No. 815 NAS, which supplied Lynxes for ship's flights and is known to have been embarked aboard RFA Largs Bay, HMS Daring and HMS Montrose at different times. ZD261 was based aboard HMS Ocean at Greenwich as part of support for the 2012 London Olympics. Retired in 2018, it has since been stored at Middle Wallop Flying Station, MOD Lyneham and MOD St. Athan.

Leonardo Merlin HM.1 ZH860
C/N 50164
No. 814 NAS
RNAS Culdrose, Cornwall, 2006
Built as a Merlin HM.1 in 2002, ZH860 was first flown on 27 March and delivered on 10 June that year to 814 NAS, nicknamed 'The Flying Tigers'. The Merlin wore this subdued tiger stripe colour scheme since at least 2006, retaining it even after conversion to HM.2 standard in 2010, although the pattern has varied. By 2018 it was back in plain overall grey.

A CMV-22B of VRM-30 is guided aboard the carrier USS George Washington *in September 2024. Some adjustments to the normal carrier launch and recovery cycle have been needed to accommodate the Osprey.* Petty Officer 3rd Class August Clawson/US Navy

Bell/Boeing V-22 Osprey

Tiltrotor Transport

A hybrid of a helicopter and a fixed-wing aircraft, the V-22 Osprey tiltrotor has been controversial for its safety record and its expense. The type has racked up extensive combat experience and is adding a new mission of carrier-based logistics to its repertoire

Tiltrotor and tilt-wing technology can be traced back to the 1950s and '60s when aircraft such as the Vought XC-142 and Canadair CL-84 were tested. The engine technology at the time relegated them to low-performance testbeds.

Such events as the failed Iranian hostage rescue of 1980 showed the need for a transport that could insert troops and extract civilians quickly without the need for multiple staging bases. The tiltrotor offered this possibility. Its advantages of speed and range over a traditional helicopter would allow it perform some missions with less time exposed over hostile territory and with a smaller logistics footprint. An example scenario of an evacuation of the US embassy in Mogadishu, Somalia, using CH-53s launched from a ship based in the Persian Gulf would take 87 hours total time, including sailing to a closer point, and require three aerial refuellings. Tiltrotors could perform the same mission in under seven hours, while refuelling only twice and with the mothership remaining where it was.

A joint Bell Helicopter and Boeing team were awarded a development contract in 1983 for the V-22 tiltrotor, which was designed around two powerful turboprop engines mounting large proprotors on nacelles that transitioned between a vertical position on the ground for vertical take-offs and landings to a horizontal

One of the V-22 engineering manufacturing development (EMD) prototypes landing on a USN amphibious ship during the lengthy test phase of the V-22

USMC MV-22B Ospreys serve with 17 operational, one training and one test squadron, but also as part of the Presidential Support Fleet with HMX-1. This example was seen departing RAF Northolt, London during President Trump's July 2018 visit to the UK. *Jim Winchester*

one for cruising flight. The broad wing could swing fore and aft and the proprotors fold for shipboard stowage,

First flown on 19 March 1989, the V-22 Osprey had a long and sometimes troubled development history, suffering a number of accidents during testing and early service, which led to a long grounding and the redesign of many components. It finally entered full operational service with the US Marine Corps in 2007 and the US Air Force in 2009. The USAF's Ospreys are designated CV-22A and are used for the combat search-and-rescue (CSAR) and Special Forces insertion roles. They have replaced both C-130 transports and MH-53 helicopters with Air Force Special Operations Command (AFSOC). The Marines use their MV-22Bs for transporting troops and lifting equipment, operating them from amphibious ships as well as land bases. Entering operational service with VMM-263 in 2007, they replaced the CH-46 Sea Knight helicopter, which suffered its own share of accidents during development and service, with 44 lost in one five year period alone.

The JGSDF operates 17 V-22s in this attractive colourscheme, and plans to deploy them to defend its southern islands, which extend close to Taiwanese waters. *Sgt. Tyler Andrews/USMC*

After two serious accidents in 2001, acquisition authority for the programme was taken away from the Navy, production was paused and the V-22s then flying were grounded. A Pentagon panel recommended production continue at a lower rate while quality control and other issues were addressed.

One shortcoming of the V-22 is that its fuselage width is constrained and cannot be increased without interfering with the arcs of the proprotors.. These in turn cannot be reduced without affecting performance, nor moved outboard without increasing the effective wingspan and thus the deck footprint for ship operations. The only vehicles it can carry are specialised buggies no wider than 60 inches (1.5m) across, and some bulky jet engines, such as that of the F-35B Lightning, can only be carried with partial disassembly.

Both Osprey versions saw extensive use during operations Enduring Freedom and Iraqi Freedom. Only one was lost in action, in Afghanistan in 2010, attributed to crew error.

The Pentagon's programme of record was for 458 Ospreys; 360 MV-22Bs and 50 CV-22s, as well as 48 HV-22s for the US Navy to use in the logistics and search-and-rescue roles. The Navy was in no hurry to take up its allotment, and it is a measure of the size of the US defence budget that the Pentagon could state a need for nearly 50 aircraft without knowing what to do with them, but the exact missions for the HV-22 was never fully defined. The designation added to the confusion with the 'H' prefix suggesting a

Showing their nacelles and proprotors in cruise configuration, an MV-22B of VMM-265 and a V-22 of the JGSDF's 107th Squadron make a formation flight over Japan. *Staff Sgt. Jose Angeles/USMC*

primary rescue role, but the Navy had no stated requirement for a new rescue aircraft.

As funded production peaked in the 2010s, the increased availability and maturity of the V-22 coincided with the search for a new logistics aircraft for supplying the US Navy's carrier fleet. This role, called Carrier Onboard Delivery or COD was fulfilled by the fixed-wing Northrop Grumman C-2A Greyhound. The prototype C-2A first flew in 1964, and the newest C-2s (purchased in 1985-87) were exceeding their planned number of landings and flight hours. Despite a Service Life Extension Programme (SLEP) to extend their potential service into the late 2020s, they were old technology. An Analysis of Alternatives (AoA) study considered either an all-new design, re-procuring the C-2 (again) or developing a COD version of the V-22. The first alternative was quickly rejected, but a choice between the Greyhound and Osprey wasn't so clear cut. The C-2 could lift more cargo with a full fuel load, but a V-22 can carry over two tonnes more from a carrier to the shore. Internal volume was greater in the C-2, but some of this was unusable and the V-22's internal freight doesn't need to be caged and secured for arrested landings and catapult shots, and the passengers can use lighter, side-mounted seats. Unlike the C-2, the CV-22 can also transport personnel and cargo to smaller ships and even to surfaced submarines.

Although the first official Osprey landing on a US aircraft carrier was not until March 2012, it is believed that one carried the body of Osama bin Laden from Abottabad, Pakistan to the USS *Carl Vinson* for burial at sea in May 2011 and that USAF CV-22s landed on carriers before then.

After a period of competitive evaluation, the Osprey was selected as the future COD platform in 2015 as the CMV-22B, with the number to be procured remaining at 48. This version features larger sponson fuel tanks, a beyond line-of-sight HF radio, improved fuel dump capability, a public address system for passengers, and a better lighting system for cargo loading. Fleet Logistics Multi-Mission Squadron VRM-30 'Titans' received its first CMV-22B in June 2020 at NAS North Island, California and achieved IOC in February 2022. The 'sundown' for the C-2 fleet is scheduled for 2028.

The only export customer to date is Japan, which ordered 17 MV-22s in November 2014.

The Japan Ground Self-Defense Force (JGSDF) established the *Yuso Kokutai* (Transport Aviation Group) for its V-22 Osprey operations in March 2020. The JGSDF operates their Ospreys in a maritime camouflage scheme and has tested them from the decks of JMSDF warships. With production for US forces beginning to wind down after 2020, the Pentagon offered favourable deals for export customers. An order for V-22s by Israel seemed likely as part of a large arms package agreed that year, but no deal was signed. Indonesia was cleared for the sale of eight CV-22s in but no sale eventuated, and Saudi Arabia showed interest. The Royal Navy had eyed the Osprey for COD, tanker and AEW&C missions, but a purchase of a small number for these roles was not deemed economic. ■

Bell-Boeing MV-22B Osprey

Crew: Three or four; up to 24 seated troops
Fuselage length: 57ft 4in (17.48m)
Rotor diameter: 38ft (12m) each
Height: 22ft 1in (6.73m), nacelles raised
Empty weight: 31,818lb (14,432kg)
All-up weight: 60,500lb (27,442 kg)
Powerplants: Two Rolls-Royce T406-AD-400 turboprop engines, each rated at 6,150shp (4,590kW)
Max speed: 316 mph (509km/h)
Range: 1,012 miles (1,628km)
Service ceiling: 25,000ft (7,600m)
Armament: One N240 7.62mm machine-gun mounted on the rear ramp. Optional Interim Defense Weapon System (IDWS) GAU-7 7.62mm Minigun in belly turret.

A prototype of the HAL Dhruv Mk. I during trials on the 'Godavari'-class guided-missile frigate IS Ganga. *The ship was decommissioned in 2018.*

HAL Dhruv

India's Indigenous Helicopter

Developed as the Advanced Light Helicopter (ALH) by Hindustan Aeronautics Ltd (HAL), the Dhruv has been produced in both land and maritime versions.

The initial maritime requirement was for 40 to be shared by the Indian Naval Air Arm and the Indian Coast Guard, but this later increased to 120 for the Navy and just seven for the Coast Guard (out of 307 for all services) by 2001. Totals were subsequently revised.

The maritime variant would have a tricycle landing gear, rather than skids, with the main units retracting into fairings on the side of the fuselage. Equipment would include a LRDE SuperVision SV-2000 surveillance radar and a harpoon deck-lock, while it was expected to operate in the ASW role. One of the five prototypes (PT-N IN901) was completed in a naval configuration, first flying on 23 December 1995. During March 1998 it participated in trials on the aircraft carrier INS Vikrant and other, smaller warships.

In May 1998 the US embargoed the AlliedSignal CTS800 engine for the ALH Dhruv, following India's nuclear tests. This forced HAL to use the Turboméca TM333-2B2 in early versions of the helicopter. Military certification for the Dhruv was granted in March 2002, allowing the first to be handed over to the Coast Guard on the 18th of that month, followed by two for the Navy ten days later, all of which were Mk Is configured for the utility role. During November the Dhruv was evaluated on the guided-missile frigate INS *Godavari*.

By October 2008 the Navy had received eight Mk Is, plus a pre-production example (IN750), later leased to the Maldives. During the same year options for the ASW variant were deferred, reportedly because it could not meet the Navy's operational requirements, citing insufficient payload and endurance, plus the unsuitability of the blade folding mechanism. Instead it would use the Dhruv for search and rescue, heliborne operations and armed patrol. The first navy squadron to be equipped, INAS332, was commissioned at INS Garuda, Cochin/Kochi, on 13 November 2013. By then, the Coast Guard had also received four Mk Is, three of which later went to the Maldives (although one was returned).

The Dhruv Mk III introduced the Shakti-1H turboshaft, a license-built Turboméca Ardiden 1H1, and other improvements; it first flew in August 1997. Sixteen Mk IIIs were ordered for each service in March 2017 for delivery between 2020 and 2022, while an additional example was added for the Navy that September. The first delivered, for the Coast Guard, was evaluated from June 2018. Mk IIIs had entered service with both services by February 2021 and all 33 had been delivered by 2023. The Coast Guard's Mk IIIs serve with CGAS830, '835, '840, '845 and '851. A further nine Mk IIIs were ordered for it in March 2024 and approval for another six granted in November 2024.

The Navy's Mk III Marine Reconnaissance variant currently flies with INAS323 at INS Baaz, Campbell Bay; INAS 324 at INS Dega, Vishakhapatnam; INAS325, INS Utkrosh at Port Blair, Andaman Islands; and from various locations with INAS321. HAL is also working on a Utility Helicopter-Marine variant to replace the Navy's HAL Chetaks. The programme was approved in March 2023, with a first flight expected in 2026. ■

HAL Dhruv Mk III

Crew: Two (pilot and co-pilot, cabin crew as required)
Fuselage length: 42ft 4in (12.89m)
Rotor diameter: 43ft 4in (13.20m)
Height: 12ft 11in (3.93m)
Empty weight: 9,800lb (4,445kg)
All-up weight: 12,125lb (5,500m)
Powerplant: Two HAL Shakti turboshafts, rated at 1,432shp (1,068kW) each
Max speed: 180mph (290km/h)
Range: 391 miles (629km)
Service ceiling: 14,440ft (4,401m)
Armament: Cabin-mounted 12.7mm Heavy Machine Gun; navy variant also has ability to carry at least two torpedoes

A NH90 helicopter of 860 Squadron Royal Netherlands Navy and an AH-64E Apache of 656 Army Air Corps (AAC) Sqn near Bardufoss, Norway in February 2024. PO (Phot) Kyle Heller/Crown Copyright

NHIndustries NH90

Multirole Multinational Muddle

The result of a complex international project which offered a large number of customer options, the NH90 is either highly effective in its various roles or a complete failure that needs replacing, depending on the experience of the different operators, or at least their determination to make it work.

NHIndustries (NHI) was formed as an international collaboration between what are now Airbus Helicopters, Leonardo Helicopters and Fokker Aerostructures in 1992. Its goal was to develop a helicopter to meet the needs of many Nato and other European nations for battlefield and naval helicopters to replace the fleets of UH-1s, Pumas, Sea Kings and other types then in service. This evolved into the NH90, a medium-sized conventional single-rotor machine with fly-by-wire controls and modern avionics.

NH90 prototype PT1 flew on 18 December 1995, but the fly-by-wire system wasn't flown

An Aéronavale Caïman lowers its Thales FLASH sonar. The NH90 replaced the Lynx and Super Frelon in the ASW role.

Airbus/Anthony Pecchi

During Exercise Dynamic Manta in 2020 an Italian navy SH-90A makes a low flyby near Catania, Sicily with Mt. Etna in the background. Jim Winchester

without mechanical backup (on PT3) until 2002. Two main versions were offered, the TTH (Tactical Transport Helicopter) and NFH (Nato Frigate Helicopter), but there have been numerous sub-variants produced for the 20 military operators in 14 countries that are produced on five production lines. Most aircraft are powered by Rolls-Royce/Turboméca RTM-322 engines, but Italy's use the GE T700-T6E1. A higher cabin was specified by Sweden and a hybrid MTT (Maritime Tactical Transport) without the search radar or ASW equipment of the NFH, but with its strengthened undercarriage and folding tail and rotors was ordered by Italy and Spain.

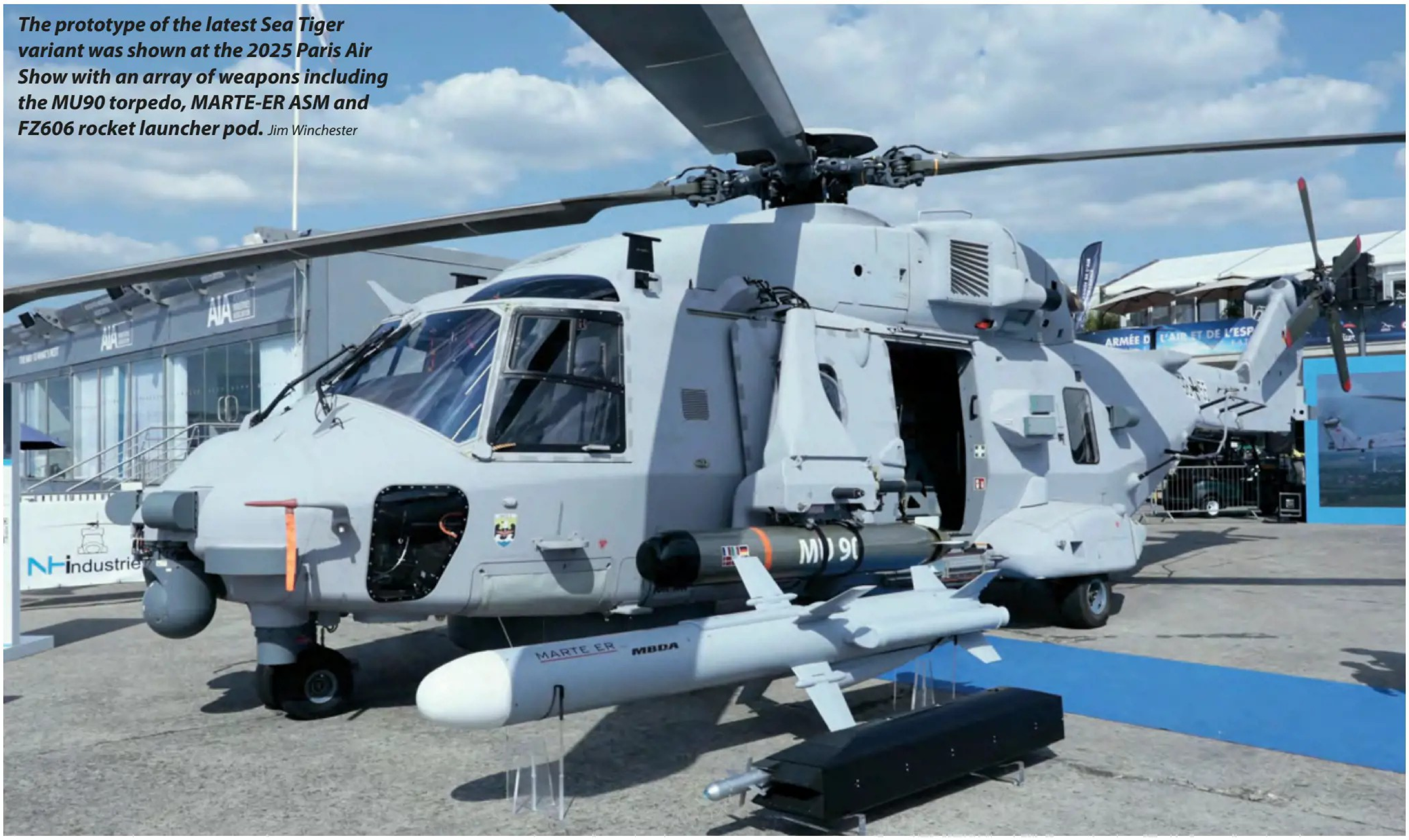
There are many sensor options including German, French or Italian versions of the same system and while countries understandably want to to protect their own avionics industries this makes data and information sharing between aircraft and operators more difficult. Things were not helped by the main members of the the NHIndustries consortium being competitors on almost every other helicopter market sector.

The Dutch navy was the first to receive the naval variant of the NH90 and the first to deploy it to sea, even though it was not fully operationally capable. During its maiden deployment more corrosion was found than expected, but this experience was fed back to the manufacturer to help improve the product and also informs the at-sea maintenance schedule. The Royal Netherlands Navy has 12 aircraft equipped as NFH models with all systems necessary for the maritime combat task and eight as Tactical NATO Frigate Helicopters (TNFH). These have the sonar and the sensor operator's control station removed. For tactical transport missions over land a missile warning system is fitted. On deployments to the Caribbean, the Dutch NH90s have conducted counter-drug surveillance, hurricane relief and policing missions.

Belgium's four NFHs are very similar to the Dutch aircraft, but currently lack ASW capability. The four TTHs are being retired, with the Belgian MOD citing operating expense and low availability. France's NH90s are named the Caïman, and are split into 34 TTH for the army and 37 NFH for the navy. The latter are used for ASW and SAR missions and in the latter role have performed some high-profile rescues. Germany's orders eventually settled to 82 TTH transports and 18 NFH variants known as the Sea Lion. The latter replaced the Sea King and were declared operational in 2022. Italy has accepted all of its 60 TTHs for the Army and the 50 NFHs and six TTHs ordered for the Navy. Italian Army NH90s were successfully deployed in Afghanistan from 2012.

Six of Australia's 47 MRH Taipans were allocated to No. 808 Naval Air Squadron, but the aircraft wore a mix of Army and Navy titles and were treated as a single fleet. The RAN deployed at sea on HMS Canberra several times a year. Introduction of the Taipan into ADF service was not smooth and it became a 'Project of Concern' in 2011. There was no single factor, but officials cited poor contracts and immature systems that led to a high maintenance burden. Unfortunately, things did not improve greatly and following two crashes, the government announced it was retiring the type in 2023. Most examples were scrapped, but one was delivered to New Zealand as an instructional airframe.

As part of the Nordic Standard Helicopter Programme, Finland, Norway and Sweden chose the NH90 in 2001. Sweden ordered 18 of the High Cabin Variant as the Hkp 14, half of which would be equipped for ASW and half for SAR/transport. Reaching operational capability was slow and UH-60 Blackhawks were ordered as an interim measure for operations in Afghanistan. In 2022 the


The prototype of the latest Sea Tiger variant was shown at the 2025 Paris Air Show with an array of weapons including the MU90 torpedo, MARTE-ER ASM and FZ606 rocket launcher pod. Jim Winchester

Swedish MoD announced the Hkp 14s would be replaced , mostly by UH-60 variants.

Norway was supposed to have 14 for Coast Guard and ASW duties in operation by 2008, but only eight were in fully capable condition by 2022 and the Norwegian MoD decided to cancel the contract and return its helicopters, citing the low reliability of the aircraft and the delay in deliveries. Finland also suffered delays, but had all of its 20 TTH variants in full service by 2018.

At the furthest end of the supply chain, the Royal New Zealand Air Force has had more success with its NH90 MRHs than some other operators and has the fleet-leading aircraft. The eight MRHs were delivered from 2011 and serve with No. 3 Squadron at Ohakea. They have frequently deployed aboard the multi-role ship HMNZS *Canterbury* for exercises in the Pacific and disaster relief missions.

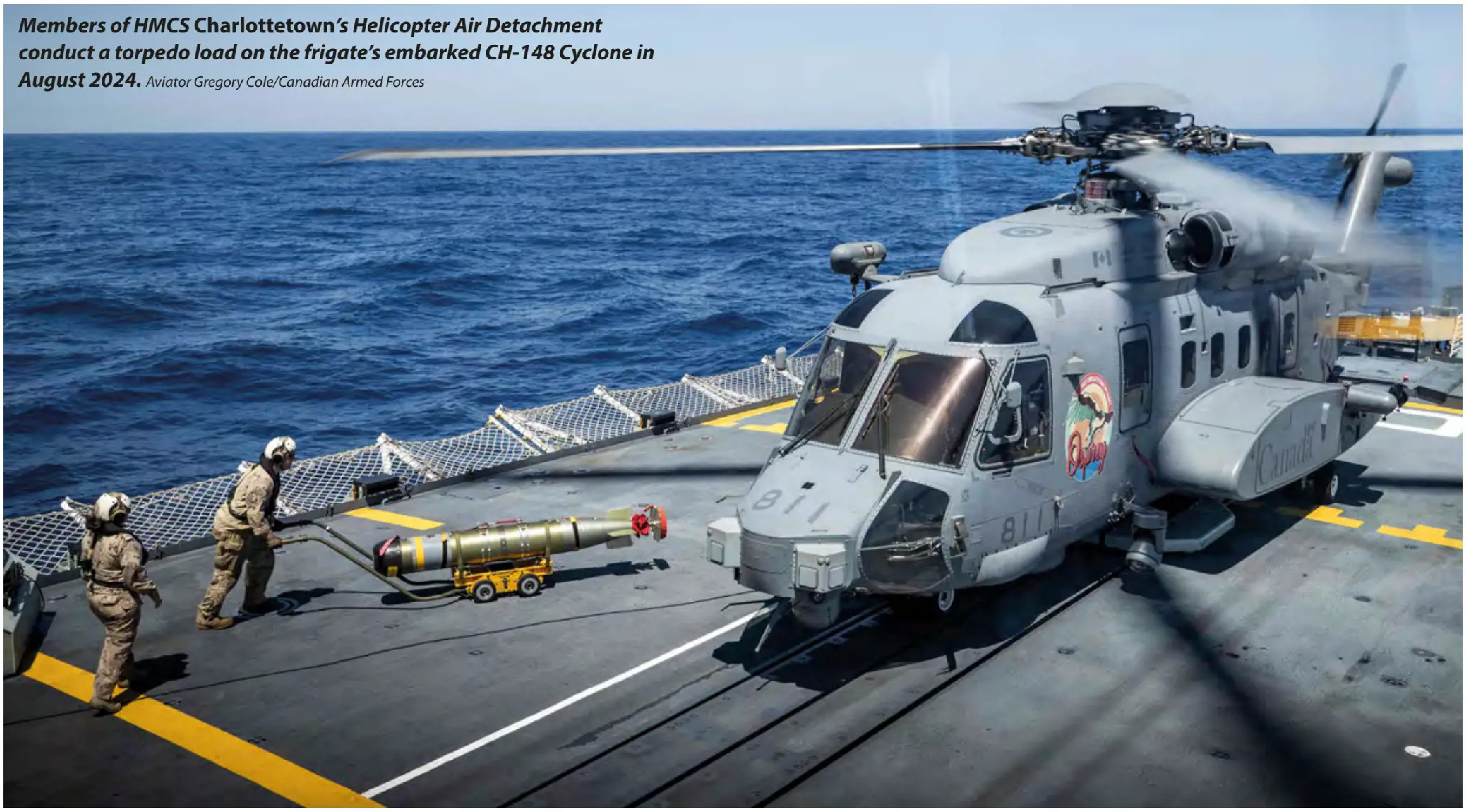
Other operators to date include Oman (20 TTHs) and Qatar (28 including 12 NFHs) and Spain (45 TTHs with GE CT7-8F5 engines). The latest variant is the Multi-Role Frigate Helicopter (MRFH) or Sea Tiger. In 2019 Germany selected it as a Westland Lynx replacement and the prototype flew in December 2023. Its airframe is the same as the Sea Lion, but it incorporates a new mission system, Leonardo's LEOSS-T electro-optical system and the ability to fire MARTE-ER anti-ship missiles. The first of 31 Sea Tigers was expected to enter service at the end of 2025.

Despite the type's varied fortunes, new customers are being sought and development continues. NHIndustries has begun a study to explore a Block 2 upgrade, likely to increase the NH90's survivability and strike capability. ■

New Zealand is one of several nations to take its NH90 TTH helicopters to sea as required. Here a No. 3 Squadron aircraft conducts currency training for aircrew on HMNZS *Canterbury* ***in the Hauraki Gulf near Auckland.*** *LAC Jenkins, RNZAF/Crown Copyright*

NH90 Naval Frigate Helicopter

Crew: Three or four
Fuselage length: 52ft 11in (16.13m)
Rotor diameter: 16.3m (53ft 6in)
Height: 17ft 5in (5.31m)
Empty weight: 14,109lb (6,400kg)
All-up weight: 23,369lb (10,600kg)
Powerplants: Two RTM-322-01/9 turboshafts, each rated at 2,388shp (1,781kW)
Max speed: 190mph (300km/h)
Range: 610 miles (982km)
Service ceiling: 20,000ft (6,000m)
Armament: MAG or M3M door gun, Mk 46 or MU 90 torpedo, MARTE anti-ship missiles, Naval Strike Missiles, 70mm guided rocket pods



Members of HMCS Charlottetown's Helicopter Air Detachment conduct a torpedo load on the frigate's embarked CH-148 Cyclone in August 2024. *Aviator Gregory Cole/Canadian Armed Forces*

Sikorsky S-92

ASW, SAR and VIP

The S-92 has been more successful in the civil market, but its CH-148 derivative is one of the most sophisticated ASW helicopters in the world, and the type has proved popular with coast guard operators.

First announced in 1992 as a commercial aircraft, with mock-ups of a 23-seat troop transport also promoted to military operators, the S-92 Helibus was formally launched at the 1995 Paris Air Show.

Flight testing with first prototype N292SA began at West Palm Beach, Florida on 23 December 1998. The second aircraft joined it in the air October the following year. Marketed primarily as a civilian oil and gas support aircraft, the initial customer was Nova Scotia-based Cougar Helicopters in 2000 and deliveries began in 2004.

The S-92 began with lot of commonality with the S-70/H-60 Blackhawk/Seahawk family, originally marrying the H-60's dynamic system with a new capacious fuselage. This proved a bit too much for the intended missions and a redesign of the dynamics was undertaken to allow higher gross weights and to meet new damage tolerance standards. A military variant, incorporating these major structural enhancements and systems upgrades flew for the first time on 9 April 2002.

In Canada, the replacement of the Sea King for shipboard use and the Labrador for land-based SAR was a long-running saga. The purchase of new helicopters was controversial and the government that entered power in 1993 made good on its campaign promise to cancel the CH-148 Petrel ASW platform and the CH-149 Chimo SAR aircraft, both based on the EHI EH101 (AW 101). The CH-149 would eventually return as the simpler Cormorant SAR aircraft based on the AW 101, and the CH-148 designation was revived in 2003 when a new government chose the S-92 as the replacement for the Sea King, with an order for 28 as the Cyclone.

The CH-148 incorporates many changes including a full-authority fly-by-wire control system. Mission equipment includes a Telephonics APS-143B radar, a Flir Systems SAFIRE III, an L-3 HELRAS sonar, and Lockheed

The S-92 is used by the UK's Maritime and Coastguard Authority for offshore and inland SAR missions. G-SARB is seen working with an RNLI 'Severn'-class lifeboat in Scottish waters. *MCA*

Two VH-92As at the 75th Anniversary Reunion of squadron HMX-1 in June 2022 at MCAS Quantico, Virginia, June.

Martin AN/ALQ-210 ESM. Delays in systems integration and certifications of upgraded engines required the RCN to operate several Sikorsky-owned aircraft as an interim measure until the first CH-148 Block 1 was delivered in June 2015. Initial operating capability was declared in June 2018.

The RCAF supplies Cyclone Helicopter Air Detachments (HELAIRDETs) to deployed Royal Canadian Navy (RCN) 'Halifax'-class frigates around the world. In 2024 these ships and their CH-148s were deployed on several operations: Neon (enforcing UN sanctions against North Korea), Horizon (Indo-Pacific patrols) and Reassurance (NATO defence and deterrence measures in Eastern Europe).Canada became the first customer to operate a variant of the S-92 primarily as a shipboard aircraft and to date remains the only one. This has led to some challenges as the pool of Cyclone-specific spare parts is small and operational availability sometimes suffers. One aircraft crashed in the Mediterranean in April 2020, with the accident attributed in part to software flaws, and the CH-148s were grounded for two months. The last Cyclone was delivered in 2025 and the remaining aircraft are being brought up to Block 2 standard.

In the civilian SAR role, His Majesty's Coastguard in the UK leases 18 examples from Bristow Helicopters. The Irish Coast Guard (Garda Cósta na hÉireann) operated five, replacing them with AW 189s in 2024. The Korean Coast Guard took delivery of four in 2014-2022.

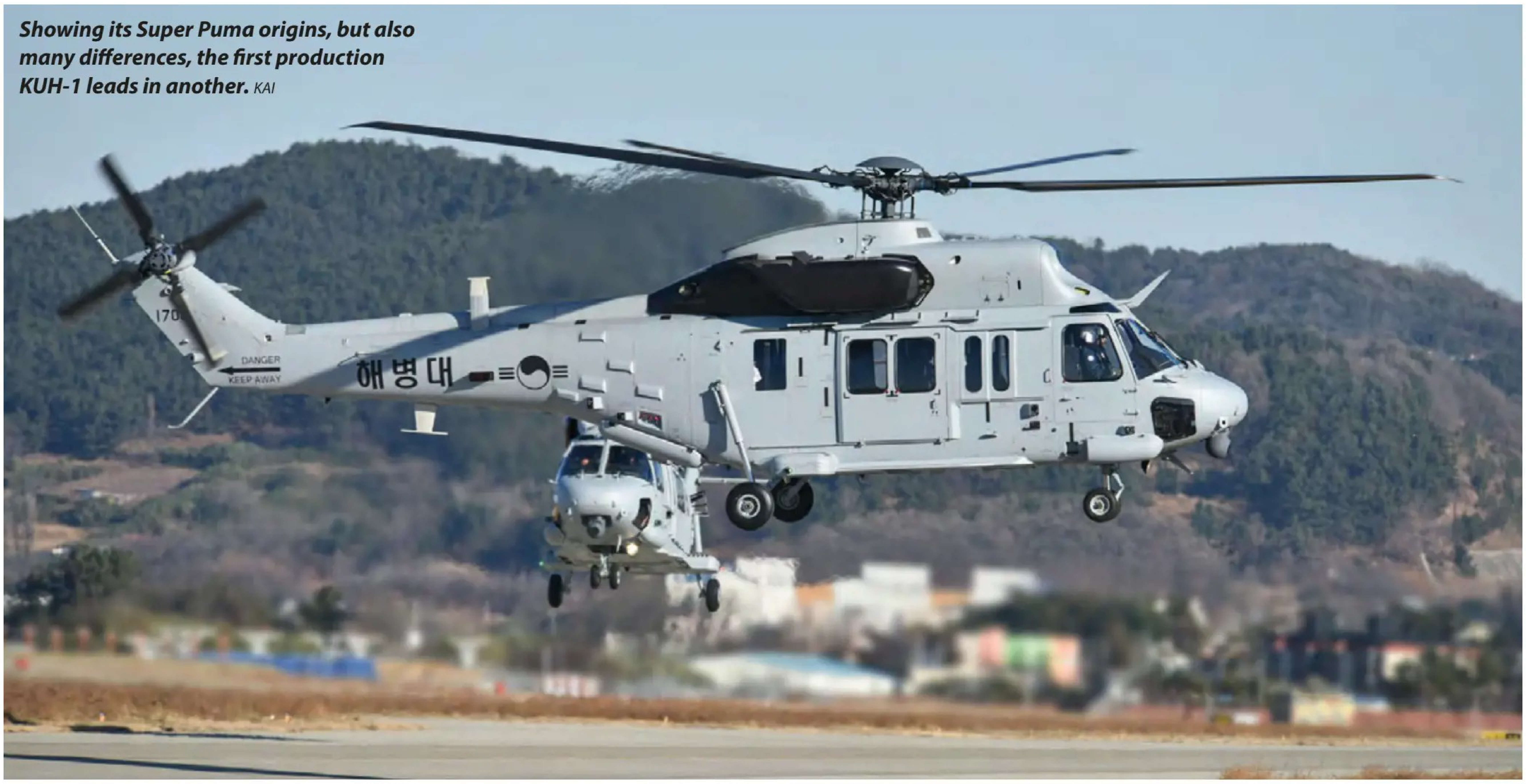
Procurement of a new Presidential Support Aircraft for the US Marines was another convoluted business, but the S-92 was selected in 2014 and production was authorised in 2019 of a modified version with enhanced mission communications system and an executive interior. The programme of record is 23, including two test aircraft. VMX-1 declared Initial Operational Capability (IOC) for the VH-92A Patriot on 28 December 2021. Operating as 'Marine One' when the commander-in-chief is aboard, the VH-92A is slowly replacing the VH-3D Sea King, although both types supported President Trump's UK visits in 2025.

The S-92 has done well in the VIP or VVIP configuration, selling to a number of governments and air arms: the Kuwait Air Force has three S-92s in VVIP configuration; the Republic of Korea Air Force has three VH-92s, delivered in 2007; the Royal Thai Air Force received three S-92As in VVIP configuration in 2011; the Bahrain Air Force has one S-92A and the Government of Turkmenistan has two.

The S-92B Superhawk, introduced in 2019, features autonomous landing technology for oil platform operation, larger cabin windows, CT7-8A6 engines and a new gearbox. It was stretched by 15cm (6in) aft of the cockpit to permit installation of a wider cabin door that could accommodate a Stokes litter during SAR operations. The tail rotor pylon was shortened to offset the extra weight of the longer cabin. Sikorsky withdrew the S-92B in 2023 following a lack of orders, but is still marketing its S-92A+ upgrade package, which has the new engines but original windows. ■

Sikorsky CH-148 Cyclone

Crew: Four
Fuselage length: 56ft 2in (17.1m)
Rotor diameter: 56ft 4in (17.17m)
Height: 21ft 2in (6.45m)
Empty weight: 15,200lb (6,893kg)
All-up weight: 26,500lb (12,018kg)
Powerplants: Two General Electric CT7-8A engines, each rated at 2,520shp (1,879kW)
Max speed: 180 miles (290km/h)
Range: 565 miles (910km)
Service ceiling: 11,500ft (3,500m)
Armament: Two Mk 46 torpedoes, self-defence machine guns mounted in doors and on ramp



Showing its Super Puma origins, but also many differences, the first production KUH-1 leads in another. *KAI*

KAI MUH-1 Marineon

Korea's all-Purpose Helicopter

The Surion family of medium helicopters has been produced or offered in a bewildering range of configurations, including several for maritime use.

Korean Aerospace Industries (KAI) developed the Surion KUH (Korean Utility Helicopter) on the basis of the Airbus AS332 Super Puma, although it uses a locally produced version of the General Electric T700 powerplant instead of the Puma's Turboméca engines.

When KAI first proposed the KUH in 2006 officials voiced ambitious plans to export 300 helicopters over 25 years, but so far the only customer outside South Korea is Iraq, which ordered two for firefighting in December 2024. The Republic of Korea's armed forces and governmental agencies have accepted large quantities, however. Preceded by a modified Super Puma in France, the true prototype KUH-1 Surion ('Perfect Eagle') first flew on 10 March 2010. Deliveries of 210 to the RoK Army began in May 2013 and were completed in 2022.

The KUH-1C civil SAR helicopter, KUH-1FS forest service variant and KUH-1EM fire fighting version have been adopted by various agencies, as has the KUH-1P Chamsuri police helicopter. Another version is the KUH-1ME for medical evacuation

The Korea Maritime Police Agency (Coast Guard) is the customer for the KUH-1CG which has search radar and an elctro-optical sensor in the nose and are equipped with AIS and a direction finder for SAR and patrol missions. In 2019 it was said that two would be deployed at Gangneung and Jeju.

A Surion Maritime Operations Variant has been promoted with a folding tail and wider-track landing gear since at least 2015, but to date none have been ordered. A navalised model has appeared in the form of the MUH Marine Utility Helicopter, described as an "amphibious helicopter", perhaps because of its integrated flotation system. Other features specific to the MUH are folding rotor blades, anti-corrosion treatment, a window washer system, a long-range HF radio and a TACAN navigation system. There is provision for auxiliary fuel tanks

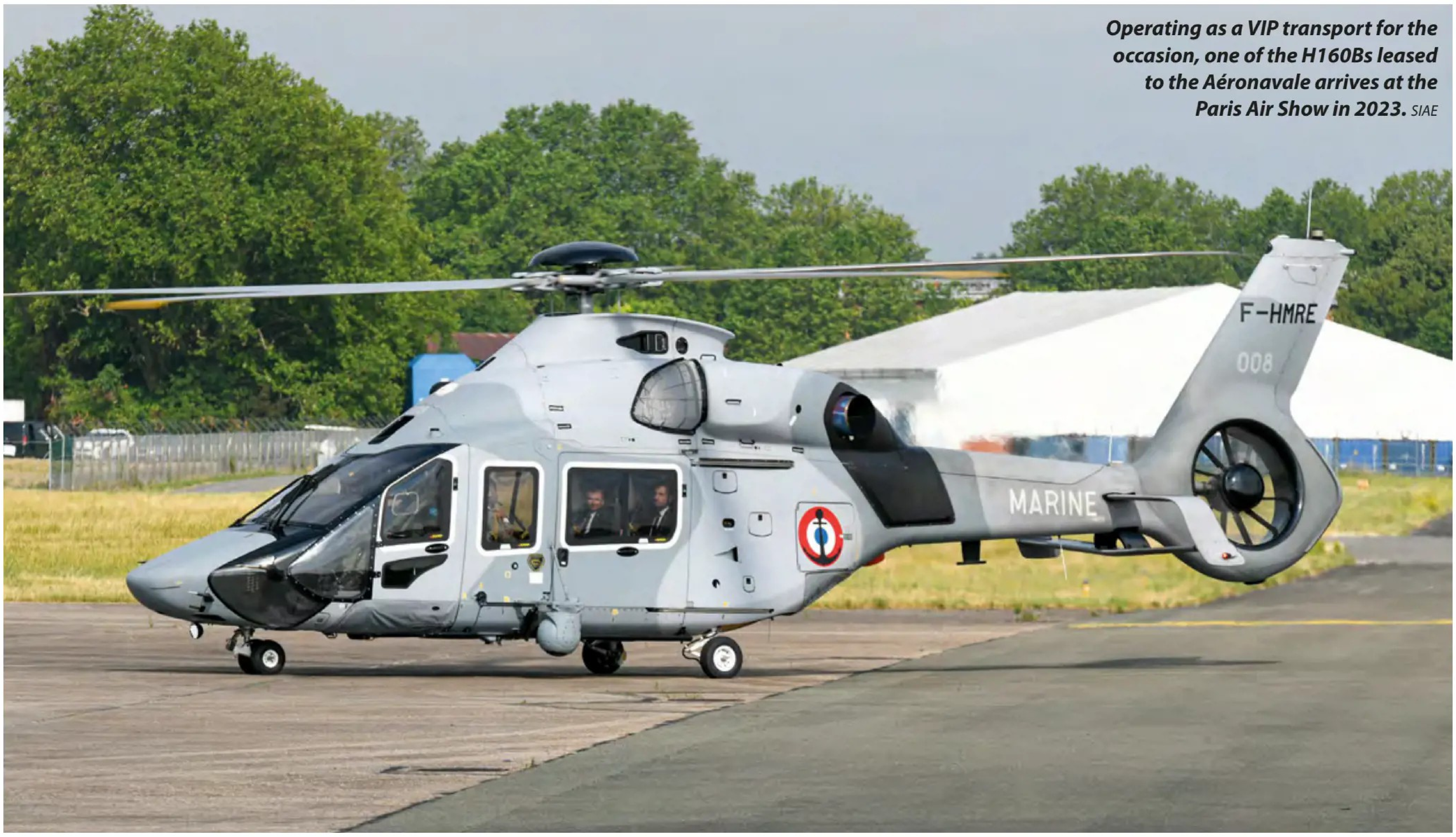
The MUH first flew on 19 January 2015. The first two were delivered to the Republic of Korea Marine Corps in January 2018. The crash of one MUH in April 2018 following a rotor system failure led to a grounding of the type and a halt to production, but the 30th and last was handed over in June 2023.

On 17 December 2024 the Marine Attack Helicopter (MAH) completed its first flight. Although details are sparse, it is an armed version of the MUH with the weapons capability of the Miron light attack helicopter. LAH weapons options include up to four Cheongeom (TAipers) anti-tank missiles or 70mm rocket pods. The MAH has stub wings for a range of ordnance and a 20mm M197 cannon in a nose turret. Development was expected to be complete in the second half of 2026, but no orders have been revealed.

A future development is the Korean Mine Countermeasures Helicopter, which will carry the Northrop Grumman Airborne Laser Mine Detection System that detects, classifies and localises floating and near-surface moored mines. ■

KUH-1 Surion

Crew: Two and capacity for 11 troops
Fuselage length: 49ft 1in (14.96m)
Rotor diameter: 51ft 10in (15.80m)
Height: 14ft 7in (4.45m)
Empty weight: 10,963lb (4,973kg)
All-up weight: 19,200lb (8,709kg)
Powerplants: Two 1,855 shp
Max speed: 167mph (269km/h)
Range: 326 miles (526km)
Service ceiling: 15,000ft (4,570m)
Armament: Door-mounted 7.62mm machine-guns



Operating as a VIP transport for the occasion, one of the H160Bs leased to the Aéronavale arrives at the Paris Air Show in 2023. SIAE

Airbus H160M Guépard

The future of naval helicopters

With a large launch order from the French government behind it, the H160M is likely to replace many helicopters in future, including those operating from smaller warships worldwide.

Built to replace the AS 365/H155 range, development of the civilian H160 preceded that of the military H160M. Work in secret as the 'X4' culminated in a roll-out of prototype PT1 in March 2015 and a first flight on 13 June.

Of conventional configuration with a wheeled undercarriage, the H160 features a Fenestron tail rotor and Airbus' new 'Blue Edge' rotor blades, which significantly reduce noise. Launch customer was Babcock, mainly known for servicing the oil and gas industry, but some others have been delivered in medical (EMS) configuration or as VIP aircraft. The French customs service has adopted the type for use in the West Indies.

Under the *Hélicoptère Interarmées Léger* - Joint Light Helicopter programme the H160M was chosen as a single platform to equip all three branches of the French armed forces—the Army (*Armée de Terre*), Navy (*Marine Nationale*), and Air and Space Force (*Armée de l'Air et le Space*). The French Ministry of Armed Forces plans to order 169 H160Ms to replace five types of helicopters currently in service with the French military or that have been recently retired. These include the Aéronavale's Alouette IIIs, Lynxes and Dauphins.

H160Ms can be equipped with the H-Force weapons system and one Airbus test aircraft has been seen carrying weapons pylons and dummy gun pods. To date there has been little mention of an ASW role or weapons for the planned naval variant.

The Aéronavale took on six H160Bs on an evaluation basis in September 2022. The aircraft are leased from Babcock but flown by French navy crews. They have been used by 32F at Lanveoc-Poulmic in Brittany, Cherbourg airport (Normandy), and at the naval air station at Hyères (Provence) mainly for SAR missions, and the unit has reported high reliability and satisfaction with them, although has experienced minor corrosion issues in the maritime environment.

Flight testing of the H160M Guépard (Cheetah) began in on 25 July 2025 with Samuel Chartier piloting the first prototype. This aircraft will primarily be used for validating the H160M's flight performance and will conduct weapons firing trials in 2026. The second prototype will be used for hot and cold weather campaigns, among other tests. The third will have structural strengthening for naval operations and the Thales AirMaster C active electronically scanned array radar intended for the naval and air force versions of the H160M.

Delivery to the *Armée de Terre* is planned in late 2028, with the first to the *Aéronavale* and any export customers not expected before 2030. ■

H160M Naval Variant

Crew: Two or three
Fuselage length: 41ft 9in (12.71m)
Rotor diameter: 44ft 0in 13.4m
Height: 16ft 1in (4.91m)
Empty weight: 8,929lb (4,050kg)
All-up weight: 13,778lb (6,250kg)
Powerplants: Two Safran Arrano 1A turboshafts, each rated at 1,300shp (970kW)
Max speed: 163mph (263km/h)
Range: 555 miles (848km)
Service ceiling: 20,000ft (6,096m)
Armament: Door-mounted machine-gun or sniper rifle, optional guided rockets

NEXT ISSUE!

Prop Trainers and Ground Attack Aircraft Since 1945

Every fighter, bomber, transport and helicopter pilot has had to learn to fly something simpler, and since World War Two that has usually been a two-seat light aircraft powered by a single piston engine or turboprop. The humble 'pilot makers' have taken tens of thousands of men and women on their first steps into military aviation careers.

Trainers have also been adapted to more aggressive roles. From the NAA AT-6 Texan to the Pilots PC-9, repurposed trainers have seen action in the counterinsurgency role and for air policing and other tasks where a jet fighter is not available, not suitable or not necessary. The type with the most aerial kills in modern military service might be the Embraer Super Tucano, used against drug-smuggling planes. Today in the Russia-Ukraine War, backseaters in piston-engined Yak-52s are shooting down explosive-laden UAVs with light machine-guns

Turbine engines have helped trainers approach the performance and handling of light jets, in some cases eliminating them from the training pipeline altogether. These days a trainee might graduate from a Texan II straight into a Typhoon or tanker.

Aviation Archive issue 83 presents the wide range of post-war training and ground attack aircraft using detailed cutaway drawings and colourful profile illustrations as well as archive and contemporary photographs.

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A Short Tucano T.1 of No. 207 Squadron RAF on a training flight over Yorkshire. *Jim Winchester*

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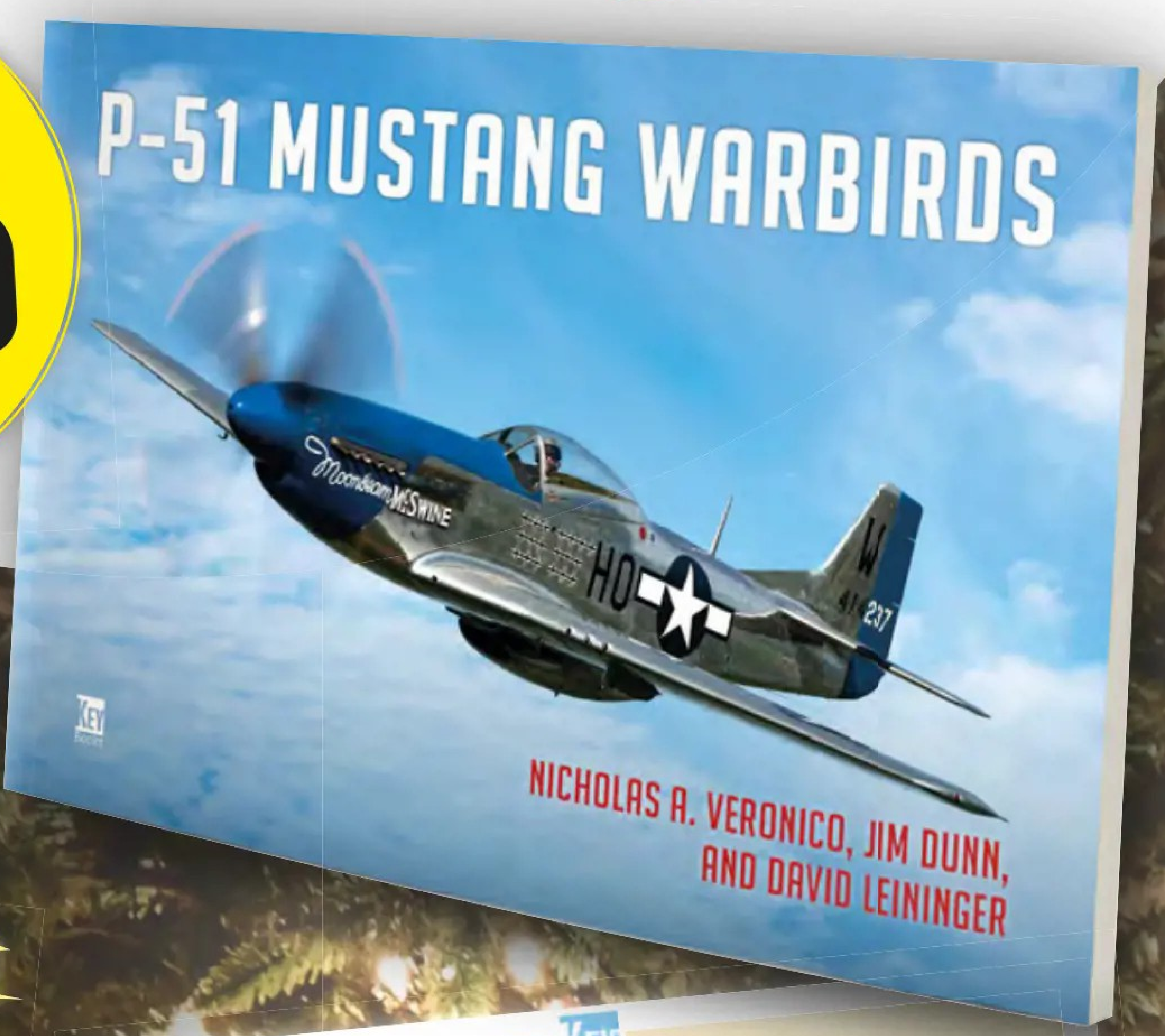
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